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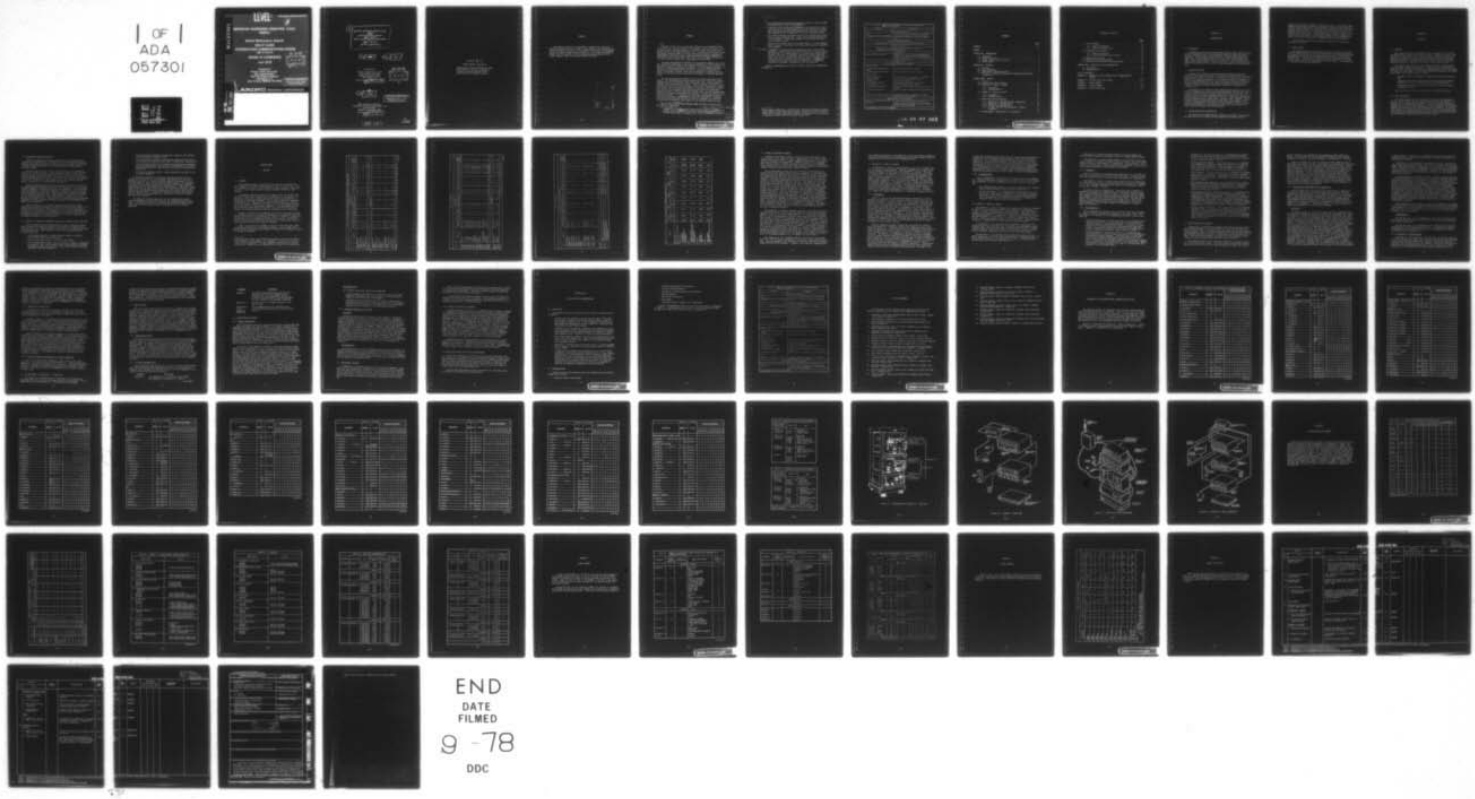

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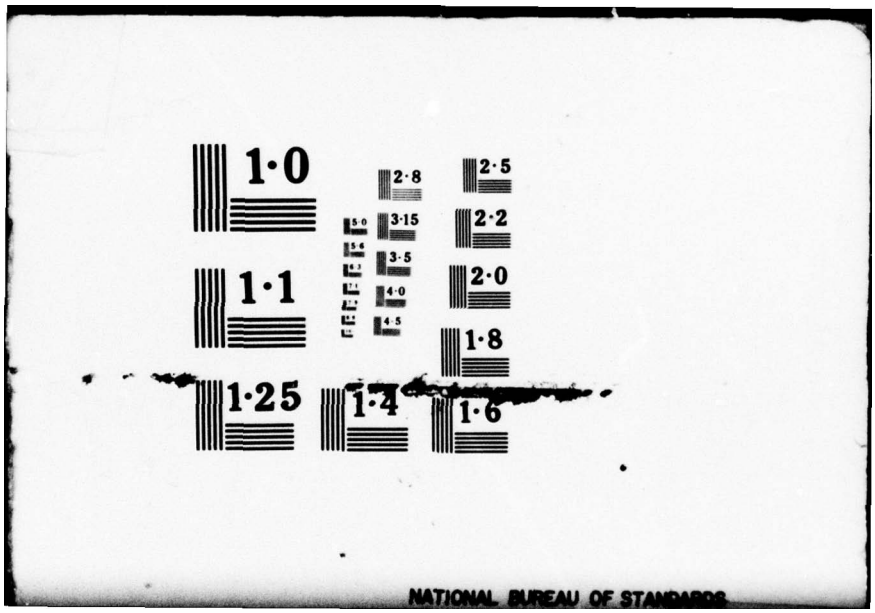
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DESTROYER ENGINEERED OPERATING CYCLE (DDEOC)

System Maintenance Analysis

DDG-37 CLASS

EXTERIOR RADIO COMMUNICATIONS SYSTEM

SMA 37-301-441

REVIEW OF EXPERIENCE

June 1978

Prepared for
Director, Escort and Cruiser
Ship Logistic Division
Naval Sea Systems Command
Washington, D. C.
under Contract N00024-78-C-4062

ARINC RESEARCH CORPORATION

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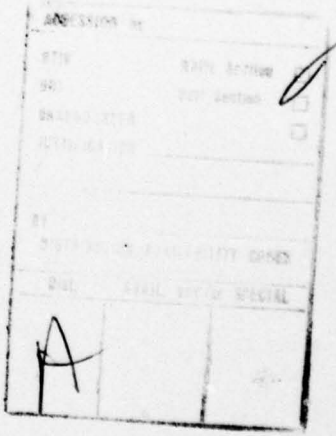
FOREWORD

This report, the Review of Experience, documents the historical maintenance experience for the DDG-37 Class Exterior Radio Communications System, presents an analysis of the problems encountered, and recommends actions to improve system material condition. It has been developed for NAVSEA 934X, the sponsor of the Destroyer Engineered Operating Cycle (DDEOC) Program, under Navy Contract N00024-78-C-4062.



SUMMARY

The goal of the Destroyer Engineered Operating Cycle (DDEOC) Program is to effect an early improvement in the material condition of ships, at an acceptable cost, while maintaining or increasing their operational availability during an extended operating cycle. In support of this goal, System Maintenance Analyses (SMAs) are being conducted for selected systems and subsystems of designated surface combatants. The principal element of an SMA is the Review of Experience (ROE). This report documents the ROE for the DDG-37 Class Exterior Radio Communications System (ERCS).

The ROE is an analysis of existing and anticipated problems that affect the operational performance or maintenance programs of a ship's system. The ROE report serves as a vehicle for assessing the significance and consequences of identified maintenance problems. It also recommends specific actions and a system maintenance policy for preventing or reducing the impact of problem occurrence, while improving material condition and maintaining or increasing system availability throughout an extended operating cycle.

The ERCS ROE included an analysis of all available maintenance data sources. The documented maintenance experience of the system was reviewed through analysis of Maintenance Data System (MDS) data, Casualty Reports (CASREPs) and system overhaul records. Initial findings from these sources were correlated with Planned Maintenance System (PMS) requirements, system alterations, and system technical manuals to identify maintenance problems. Ship surveys were conducted and discussions were held with appropriate technical codes to validate identified problem areas, identify undocumented maintenance problems, and determine the status of current and planned actions affecting the ERCS. All findings were evaluated, and appropriate conclusions were developed. Recommendations were then formulated to implement existing and newly defined corrective actions to minimize the occurrence of identified problems and their impact on the extended operating cycle.

The following are among the major findings and conclusions resulting from this Review of Experience:

- A majority of the equipments constituting the DDG-37 Class Exterior Radio Communications System (ERCS) is the same as that of the FF-1052 Class; consequently, action is already being taken to implement most of the recommended reliability

and maintainability improvements listed in Table S-1 that resulted from the previous FF-1052 Class ERCS SMA.*

- A majority of the operational inadequacies and repetitive circuit failures relating to NTDS equipment have been identified by equipment acquisition and maintenance managers for redesign or improvement; NAVELEX action is under way to correct these deficiencies.
- Major ERCS equipments primarily consist of an integration of units, most of which are modularized. Depot-level repairable modules are in short supply for some units because of long turnaround times while undergoing repair.
- Decisions to overhaul units of the ERCS should, by current NAVELEX policy, depend on inspection and testing rather than on a predetermined schedule.
- A combination of maintenance strategies are now in use for ERCS equipments. Essentially, these strategies are (1) clean, preserve, and lubricate on a scheduled basis; (2) periodically conduct performance tests and, as necessary, restore to a given functional level; and (3) for various 'go/no-go' or noncritical items, run-to-failure and 'fix or replace' when failure occurs. The analysis confirmed that current practices are effective, and preventive measures are adequately implemented by the existing PMS.

Specific recommendations resulting from this analysis are summarized in Table S-1.

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*ARINC Research Publication 1652-30-1-1673, *Destroyer Engineered Operating Cycle (DDEOC), System Maintenance Analysis, FF-1052 Class Exterior Radio Communications System, SMA 302-441, Review of Experience*, by T. Moore and R. Sangster, Contract N00024-78-C-4062, October 1977.

Table S-1. SUMMARY OF ROE RECOMMENDATIONS FOR THE DDG-37 CLASS EXTERIOR RADIO COMMUNICATIONS SYSTEM (ERCS)

Component	Recommendation
Baseline Overhaul Requirements	
Bonding	Inspect for proper bonding at POT&I; correct during BOH.
Overhaul status of digital data communications (SWBS 415) and radio systems (SWBS 441)	Change Repair Requirements for BOH (DDG-37 Class) from "requirement" to "reservation"; include all equipment in POT&I.
Intra-Cycle Maintenance Requirements	
Scheduled restorative maintenance will not be required during the intra-cycle.	
Follow-on ROH Requirements	
Follow-on restorative maintenance should be accomplished as shown to be necessary by the ship's CSMP and POT&I results.	
IMA Improvements	
Destroyer tender test facilities	Depending on the results of the ILS recommendation with respect to supply support, investigate the technical feasibility and cost-effectiveness of installing shop facilities for testing critical items.
PMS Changes - None.	
Reliability and Maintainability Improvements	
AN/SRC-20( ) Family	
RF and PA, FMO, and Audio Amplifier Modules*	Install solid-state modules, as available.
Centrifugal Fan and Speed Increaser	Design and develop low-rpm alarm field change.
AN/WRC-1( ) Family	
Translator/Synthesizer*	Provide replacement solid-state modules, as available.
Frequency Standard*	Give priority to providing modified modules.
RF Amplifier*	Provide solid-state module.
Final Transformer Assembly*	Provide improved commercially available modules.
DC-DC Converter*	Provide field change to improve module.
Wire Antenna Strain Insulators*	Procure and backfit insulators with grounding strap stud in place.
Simo-Keying HF Transmitters*	Develop field change or ShipAlt to permit simo-key operation.
NTDS	
AN/SRC-23( ) RF PA Module, NIIN 111-7152	Investigate feasibility of redesigning RF PA module to incorporate solid-state technology.
Integrated Logistic Support Requirements	
AN/SRC-23( ) RF PA Module, NIIN 111-7152	Increase on-board spares allowance from one to two.
Supply Support	Initiate a study for determining to what extent the ERCS repairable assemblies and modules not in need of repair are being returned for refurbishment.

*Also recommended in the FF-1052 Class ERCS SMA.

CONTENTS

CONTENTS (continued)

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

In support of the Destroyer Engineered Operating Cycle (DDEOC) Program sponsored by NAVSEA 934X, System Maintenance Analyses (SMAs) are being conducted on selected systems and subsystems of program-designated surface combatants. The principal element of an SMA is the Review of Experience (ROE). This report documents the ROE for the DDG-37 Class Exterior Radio Communications System (ERCS), which was selected for analysis because equipments of this system are on the DDG-37 Class Maintenance Critical Equipment List.

1.2 PURPOSE AND SCOPE

The ROE is an analysis of existing and anticipated problems that affect the operational performance or maintenance programs of a ship's system. The ROE report serves as a vehicle for assessing the significance and consequences of identified problems. It also presents specific recommendations and a system maintenance policy directed toward preventing or reducing the impact of problem occurrence while improving material condition and maintaining or increasing system availability throughout an extended ship operating cycle.

The analysis of the Exterior Radio Communications System of the DDG-37 Class was concerned with only those system components that had been installed or were on board ship as of the fourth quarter of Fiscal Year 1976. The analysis used all available documented data sources from which system maintenance problems could be identified and studied. These data were obtained from the Maintenance Data System (MDS), Casualty Reports (CASREPs), system overhaul records, Planned Maintenance System (PMS) requirements, system alteration documentation, and system technical manuals. Sources of undocumented data employed in this analysis included discussions with Ship's Force and other cognizant technical personnel.

1.3 SYSTEM FUNCTION AND DESCRIPTION

The Exterior Radio Communications System for the DDG-37 Class provides the ships with voice, record, and data communications between various

surface, air, and shore elements of the Naval Service. The Exterior Radio Communications System consists of transmitters, receivers, and their associated antennas designed to function within specified ranges of the radio frequency (RF) spectrum. The ranges most frequently used are the high frequency (HF) range (from 3 to 30 MHz) and the ultra-high frequency (UHF) range (from 200 to 400 MHz). Various switchboards and patch panels are included within the ERCS to permit remote operation of the equipment, as well as to provide flexibility in equipment usage and maintainability.

A list of the major system components included in the analysis is provided in Appendix A.

1.4 REPORT FORMAT

The remaining chapters of this report describe the analysis approach utilized (Chapter Two), briefly define significant system maintenance problems encountered and discuss potential problem solutions (Chapter Three), and summarize conclusions and recommendations derived from the analysis (Chapter Four). Specific analyses and evaluations supporting the results of this effort are included as appendixes to this report. A selected list of references precedes the appendixes.

CHAPTER TWO

APPROACH

2.1 OVERVIEW

This chapter describes the approach to the performance of the ROE for the Exterior Radio Communications System (ERCS). Primary data sources were identified in Section 1.2. These data were used to identify, define, and analyze maintenance problems that will significantly affect the system's maintenance program. A recommended course of action relative to the maintenance program was formulated on the basis of the analysis results.

The analysis was initiated at the component level at which Allowance Parts List (APL) numbers are assigned. In some instances, components for which APLs are individually assigned were analyzed generically in APL groups to assess the group impact on the overall maintenance program for the system. Major steps of the analysis were as follows:

- Compiling relevant documented and undocumented maintenance history data
- Analyzing these data to identify and define maintenance problems expected to have a significant impact on system maintenance
- Recommending a specific course of action for solution of system maintenance problems

Each of these activities is described in the following sections.

2.2 DATA COMPILATION

The analysis began with the compilation of data on the maintenance history of the system. The data file consisted of four key elements: an MDS data bank, a CASREP narrative summary, a system overhaul experience summary, and a system ShipAlt summary. A library of appropriate technical manuals, bulletins, and related documents was also assembled. All MDS data reported for the DDG-37 Class from 1 January 1970 through 31 October 1976 were screened for information pertinent to the system. Overhaul experience was obtained from Mechanized Departure Reports and authorized Ship Alteration and Repair Packages (SARPs) for the DDG-37 Class.

2.3 MAINTENANCE PROBLEM DEFINITION

Potential maintenance problems associated with the system and its components were identified by a screening process employing data obtained from the above-described sources as well as from ship surveys, discussions with Navy technical personnel, and, when appropriate, NAVSEA special-interest programs.

MDS data constituted the initial and primary source of information used in the screening process. This data base includes all part and labor records, as well as narrative material, describing maintenance actions reported against system components. Maintenance actions are represented by Job Control Numbers (JCNs). The purpose of the first step in the screening process was to identify the maintenance actions that had been reported against components of the system under investigation.

Computer-assisted analysis was next employed to quantify the man-hour and part-expenditure burdens incurred for each component, not only for the selected components individually but also, as appropriate, for each generic class of components. Individual components or component classes that had contributed significantly to the system's maintenance burden were selected for the analysis described below. Components were also selected for analysis if they had generated a significant number of CASREPs or if other sources of information (e.g., ship surveys or overhaul experience) disclosed significant concern regarding maintenance problems or the maintenance programs for the components.

Detailed analysis of the selected components was directed toward defining each maintenance problem in terms of several specific factors: the effect of the problem on the component and system, the interval between occurrences of the problem, the redundancy of the affected components within the system, the criticality of the component to the system, the resources required to perform the maintenance necessary to correct the problem, and the expected component or system downtime.

2.4 ANALYSIS OF COMPONENT MAINTENANCE PROBLEMS AND DEFINITION OF SOLUTIONS

Once the component maintenance problems and their causes were identified, solutions were sought by examining each problem in relation to the extent to which it is recognized and its susceptibility to established types of corrective action. These analysis criteria can be expressed by the following questions:

- Is the problem known to the Navy technical community and has a solution been proposed or established?
- Will a design change reduce or eliminate the problem?
- Is the problem PMS-related? Can the problem be reduced or eliminated by changes to PMS? (These changes might include adding or deleting requirements, changing periodicity, or developing material condition assessment tests and procedures.)

- Can the problem be reduced or eliminated by improving the system's Integrated Logistics Support (ILS)?
- Can the problem be reduced or eliminated by improving Ship's Force, Intermediate Maintenance Activity (IMA), or depot-level capabilities?
- Can the problem be reduced or eliminated by periodically performing restorative maintenance? Should this be accomplished at a Selected Restricted Availability (SRA) by Ship's Force, IMA, or depot-level facilities?
- Is the run-to-failure concept a viable maintenance strategy for the associated equipment?

An affirmative answer to any question resulted in analysis of the effects of the solution and in an estimate, when possible, of the cost to implement the solution. A negative answer prompted the analyst to go to the next question. After all the questions were answered, the alternative near-term and long-term solutions were evaluated and the most acceptable alternatives defined and documented as recommendations. "Near-term" recommended solutions, as used in this report, are those that should be, and are likely to be, accomplished before completion of the initial DDG-37 Class Baseline Overhaul (BOH). "Long-term" recommended solutions are those that are not likely to be accomplished until some or all of the DDG-37 Class BOHs have been completed.

The historical overhaul experience for all installations of each selected component was then correlated with the recommended problem solutions. An evaluation was made to establish the Baseline Overhaul, intracycle, and follow-on Regular Overhaul requirements for each selected component.

CHAPTER THREE

RESULTS

3.1 OVERVIEW

This chapter presents the results of the analysis of the Exterior Radio Communications System (ERCS) installed in DDG-37 Class ships. Table A-1 (Appendix A) provides a detailed list of these equipments. Subsequent sections of this chapter discuss problems identified during the data analysis.

Certain ERCS equipment families are common to both the FF-1052 Class and DDG-37 Class ships. Specifically, the AN/SRC-20( ) and AN/WRC-1( )* families of radios are installed aboard both classes but differ only in quantities of individual equipment. This analysis showed that equipments on the DDG-37 Class experienced maintenance problems similar to those of the FF-1052 Class. Therefore, the results of the FF-1052 SMA are applicable to the DDG-37 for these common equipments. The recommendations from the FF-1052 Class SMA common to the DDG-37 are provided in this report; however, the detailed supporting data are available in the FF-1052 SMA.

Analysis of MDS data for equipments of the DDG-37 Class ERCS resulted in the identification of 35 separate equipments as accounting for the major portion of the system maintenance burden. Table 3-1 presents a summary of the MDS data for these equipments during the data period. Collectively, these 35 equipments accounted for 90.0 percent of the parts-cost burden and 81.8 percent of the man-hour burden for the ERCS.

Table 3-2 lists the total number of repair actions, the total number of repairs requiring parts, and deferral actions. It also shows the reported causes of failures and the degree of degradation in capability caused by the failed components.

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*Throughout this report, open parentheses included as part of the identification number of an equipment, e.g., AN/WRC-1( ), are used to indicate that follow-on versions of the same equipment identified with a specific letter, e.g., AN/WRC-1(B), are understood to be a part of the discussion.

Table 3-1. MDS DATA SUMMARY OF SELECTED EQUIPMENTS FOR THE EXTERIOR RADIO COMMUNICATIONS SYSTEM

APL	Nomenclature	Applicable Ships	Components per Ship (Typical)	Total Component Population	Total Ship Operating Time (Ship-Years)	Ships Reported	JCNs	Ship's Force Man-Hours	IMA Man-Hours	Total Man-Hours	Parts Cost (Dollars)	Average Man-Hours/ Component Operating Year
AN/SRC-20 Family												
58439716 58439720	AN/URC-9( )	37-46	4	35	187.6	10	466	2,736	18	2,754	155,490	14.7
57112000 57112002	AN/SRC-20( )	37-46	4	48	250.1	10	1,099	5,110	439	5,549	375,210	22.2
57112100 57112102	AN/SRC-21( )	37-46	2	25	128.1	10	454	2,786	46	2,832	85,804	22.1
57102300	AN/SRA-33( )	37-46	1	13	71.6	8	55	421	0	421	17,356	5.9
Subtotal							2,074	11,053	503	11,556	633,860	
AN/WRC-1 Family												
88485700 88485702 88485704	T-827( )	37-46	3	30	163.9	4	8	31	0	31	1,460	0.2
59001100 59001105	AN/WRC-1( )	37-46	1	10	52.1	10	77	323	0	323	31,119	6.2
81095100 81095102 81099010 81101551	R-1051( )	37-46	12	122	634.9	10	651	2,145	385	2,530	483,732	4.0
58557823	AN/URT-23( )	37,38,42,46	5	20	111.8	2	22	156	21	177	15,095	1.6
58433800 58433801	AN/URA-38( )	37-40,43-46	2	17	92.3	8	95	438	8	446	10,213	4.8
58557824	AN/URT-24( )	42	2	2	10.0	1	9	7	0	7	4,979	0.7
52300700	AM-3007	37-46	1	12	62.0	5	23	80	0	80	3,692	1.3
62688437	CU-917( )	37-46	1	15	79.2	7	19	86	0	86	10,115	1.1
Subtotal							904	3,266	414	3,680	560,405	

(continued)

Table 3-1. (continued)

APL	Nomenclature	Applicable Ships	Components per Ship (Typical)	Total Component Population	Total Ship Operating Time (Ship-Years)	Ships Reported	JCNs	Ship's Force Man-Hours	IMA Man-Hours	Total Man-Hours	Parts Cost (Dollars)	Average Man-Hours/ Component Operating Year
NTDS Equipments												
57112300 57112303	AN/SRC-23( )	37-40, 43-46	2	14	75.4	9	188	1,209	60	1,269	334,270	16.9
81130916	R-1361	37-40, 43-46	2	14	59.2	7	45	159	0	159	79,805	2.7
61397484	C-4784A	37-40, 43-46	2	16	87.1	5	12	72	0	72	8,769	0.8
88485894	T-1004	37-40, 43-46	2	16	86.6	7	28	242	0	242	23,600	2.8
61397486	C-4785A	37-40, 43-46	2	14	75.3	5	12	44	0	44	5,115	0.6
52379890	AM-3790	37-40, 43-46	2	16	86.6	7	67	359	0	359	96,027	4.1
78047492	OA-4792	37-40, 43-46	1	8	43.3	8	27	72	15	87	10,867	2.0
57113110	AN/SRC-31(B)	37-46	2	19	99.3	6	99	2,504	8	2,512	238,064	33.7
57110801	AN/SRC-16( )	41,42,44	1	3	14.6	2	71	327	0	327	82,732	22.4
62689069	CU-1169	37-40, 43-46	8	64	346.5	5	15	90	0	90	26,996	0.3
57102304 57102334	AN/SRA-34( )	37-40, 43-46	1	13	69.7	7	76	498	30	528	57,230	7.6
78047494	OA-4794(A)/SRA-34	37-40, 43-46	1	13	69.7	6	13	33	7	40	13,674	1.1
76384628	MX-4847(B)/SRA-34	37-40, 43-46	1	13	69.7	8	34	100	0	100	3,279	1.4
62689559	CU-1559/SRC	37-46	1	10	52.1	3	21	100	0	100	6,504	1.9
57101400	AN/SRA-22( )	39-44	3	10	73.4	6	68	754	28	782	64,349	10.7
Subtotal							776	6,563	148	6,711	1,051,281	
VHF Equipments												
58841200 58841201	AN/VRC-46(V)( )	37-40, 43-46	1	7	35.2	6	41	1,609	5	1,614	1,930	54.8
58556509	AN/URT-7( )	37-46	1	10	52.1	10	58	126	0	126	7,065	2.4
58535100	AN/URR-27	37-46	1	10	52.1	10	51	241	43	284	775	5.4
Subtotal							150	1,976	48	2,024	9,770	

(continued)

Table 3-1. (continued)

Other Equipment (Includes Antennas and Couplers)

APL	Nomenclature	Applicable Ships	Components per Ship (Typical)	Total Component Population	Total Ship Operating Time (Ship-Years)	Ships Reported	JCNs	Ship's Force Man-Hours	IMA Man-Hours	Total Man-Hours	Parts Cost (Dollars)	Average Man-Hours/ Component Operating Year
56619800	AN/PRC-77	37-40,43-45	2	14	74.5	7	13	12	0	12	1,590	0.2
54390900 54390901	AN/CRT-3( )	37-46	3	30	156.4	8	22	47	23	70	758	0.4
58439200	AN/URC-4( )	39-42,45	3	30	157.4	8	17	40	14	54	1,925	0.3
58532400 58532405	AN/URQ-10( )	37-46	1	10	52.1	8	24	148	124	272	292	5.2
52212301 52212302	AM-2123( )	37-46	3	30	156.4	10	36	192	6	198	1,634	1.3
57043600 57100301 57100310 57100315	AN/SRA-12( )	37-46	1	14	70.5	10	36	81	2	83	5,289	1.2
57103223	AN/SRA-43	37-40,42-46	6	50	269.8	9	43	123	0	123	7,263	0.5
57102357	AN/SRA-57	37-40,43-46	1	8	43.3	9	33	1,535	3	1,538	1,159	35.5
57102358	AN/SRA-58	37-40,43-46	1	8	43.3	7	26	161	0	161	2,024	3.7
59005300 59005301	AN/WRR-3( )	37-46	3	28	146.7	10	81	267	40	307	6,807	2.1
57100800	AN/SRA-17/U	37-46	4	37	195.3	8	49	129	0	129	310	0.7
06604700	66047 WHIP	37-45	7	61	318.2	8	60	276	48	324	2,558	1.0
59309981	AS-2573( )	46	3	3	16.3	1	10	85	25	110	5	6.8
Subtotal							450	3,096	285	3,381	31,614	
	Total						4,354	29,954	1,398	27,352	2,286,930	
	Total Reported for All System APLs						5,421	31,449	1,997	33,446	2,539.632	
	Percent of Total Reported Accounted for by Selected APLs						80.3	82.5	70.0	81.8	90.0	

Table 3-2. SELECTED MDS DATA FOR EXTERIOR RADIO COMMUNICATIONS SYSTEM

Description	AN/SRC-20( ) Family		AN/WRC-1( ) Family		NTDS Equipment		VHF Equipment		Other Equipment		ERCS	
	Total	Percent of Total	Total	Percent of Total	Total	Percent of Total	Total	Percent of Total	Total	Percent of Total	Total	Percent of Total
Number of Repairs	1445	100.0	659	100.0	423	100.0	94	100.0	635	100.0	3256	100.0
Number of Repairs Requiring Parts	1183	81.9	469	71.2	310	73.3	50	53.2	345	53.5	2357	72.4
When Discovered												
During Operations	725	50.2	263	39.9	134	31.7	19	20.2	175	27.6	1316	40.4
During Inspection	213	14.7	77	11.7	35	8.3	22	23.4	192	30.2	539	16.6
During PMS or System Test	232	16.1	176	26.7	151	35.7	20	21.3	79	12.4	658	20.2
When Lighting Off	178	12.3	51	7.7	58	13.7	14	14.9	87	13.7	388	11.9
Not Applicable	97	6.7	92	14.0	45	10.6	19	20.2	102	16.1	355	10.9
Cause												
Normal Wear and Tear	1066	73.8	444	67.4	282	66.7	46	48.9	327	51.5	2165	66.5
Manufacture or Installation Defects	35	2.4	14	2.1	16	3.8	5	5.3	14	2.2	84	2.6
Inadequate Instruction or Design	70	4.8	33	5.0	23	5.4	3	3.2	44	7.0	173	5.3
Abnormal Environment	43	3.0	11	1.7	7	1.6	1	1.1	39	6.1	101	3.1
Not Applicable	231	16.0	157	23.8	95	22.5	39	41.5	211	33.2	733	22.5
Capability												
Operational	221	15.3	125	19.0	67	15.8	13	13.8	131	20.6	557	17.1
Nonoperational	719	49.7	310	47.0	205	48.5	41	43.6	253	39.8	1528	46.9
Reduced Capability	443	30.7	180	27.3	117	27.7	21	22.4	154	24.3	915	28.1
Other	62	4.3	44	6.7	34	8.0	19	20.2	97	15.3	256	7.9
Deferrals												
Lack of Material	362	25.1	228	34.6	111	26.2	23	24.5	110	17.3	834	
Outside Assistance	86	6.0	47	7.1	58	13.7	19	20.2	128	20.2	338	
Work Backlog or Operational Priority	91	6.3	47	7.1	33	7.8	16	17.0	104	16.4	291	
Other	62	4.3	49	7.4	21	5.0	9	9.6	51	8.0	192	

3.2 CURRENT IMPROVEMENT PROGRAMS

Equipments comprising the ERCS of the DDG-37 Class have been in the fleet inventory for a number of years. Improvements in the form of field changes have been provided to correct equipment deficiencies. For example, since the mid-1960s, the AN/SRC-20C( ) family has had up to 18 separate field changes issued to promote operational availability of the equipment. These improvements are a continuing effort under the guidance of acquisition managers within the Naval Electronics Systems Command.

Other improvements include the use of satellite communications and installation of more modern state-of-the-art equipment. In mid-1976, two maritime satellites (MARISAT) were launched, providing the Navy with satellite communications over both the Atlantic and Pacific Oceans. The Fleet Broadcast, which had been principally transmitted by HF for more than two decades, is currently transmitted by UHF via satellite and is received on board ship by the AN/SSR-1 satellite receiver. The AN/WSC-3( ) is a UHF transceiver providing both satellite and direct line-of-sight (LOS) communications in the 225 to 400 MHz range. With the satellite modules eliminated, it is a simple LOS AM transceiver. This equipment was introduced to the fleet in early 1976 as the Tactical Satellite Communication (TACSATCOM) transceiver. With the installation of the AN/WSC-3( ) TACSATCOM transceivers, DDG-37 Class ships will have the capability of two-way ship-to-shore communications via the satellite. Use of the satellite permits less radiated power, permits higher data transfer rates, and operates more favorably under all atmospheric conditions in comparison with HF transmissions. All ships of the class are currently fitted with the AN/SSR-1( ), while installation of AN/WSC-3( ) is proceeding in accordance with the ship's overhaul schedules and the availability of equipments. The AN/WSC-3( ) for the DDG-37 Class has not yet generated sufficient MDS data to allow for a meaningful analysis.

The AN/SRC-20( ) acquisition manager reported that the Navy intends to replace the AN/SRC-20( ) family with the AN/WSC-3( ) but without satellite capability for use in UHF LOS communications. The acquisition of the AN/WSC-3( ) in this configuration is now an item in the Five-Year Development Plan; however, it will not be available to the fleet for several years. By the time these follow-on equipments are available, the AN/SRC-20( ) family will have been in the fleet for approximately 20 years. The replacement of the AN/SRC-20( ) family of radios with the AN/WSC-3( ) equipments is justified in view of the equipment age and the amount of maintenance required. It is further justified because the AN-WSC-3( ) design includes electronic synthesis, solid-state modules, and other state-of-the-art improvements. Planned improvements to some of the AN-SRC-20( ) family modules will suffice for the short term and ensure that the equipments will remain serviceable until the replacement AN/WSC-3( ) is available for installation.

This analysis has not considered changes to maintenance requirements that may occur due to the introduction of satellite communications equipment. This new equipment will now share the operating load of long-distance communications with HF equipment. However, since satellite communications

(as currently configured) do not answer all of the long-distance communications requirements, such as over-the-horizon ship-to-ship communications, HF equipment will be required for the foreseeable future.

3.3 AN/SRC-20( ) FAMILY OF RADIOS

The AN/SRC-20( ) family of radios operate in the 225 to 400 MHz range for line-of-sight communications. Table A-2 (Appendix A) provides a list of the equipments and components of the AN/SRC-20( ) family. The three transceiver members of this family are uniquely interrelated (see Figure A-1, Appendix A). The AN/URC-9( ) is both a stand-alone equipment and a radio set contained within the other two transceiver equipments of the family. When the AN/URC-9( ) is installed with Radio Set Control C-3866, which permits selection of any one of 19 preset channels, the combination is designated AN/SRC-21( ). An AN/URC-9( ) and a C-3866, when joined with the 100-watt linear amplifier AM-1565, constitute the AN/SRC-20( ) -- the third transceiver member of the family. The antenna coupler AN/SRA-33 consists of four separate coupling units, accommodating four separate transceivers operating simultaneously with one UHF antenna. The AN/SRC-20( ) family has replaced the AN/GRC-27( ) equipments throughout the class.

3.3.1 Discussion

Table 3-1 lists a total reported maintenance expenditure of 11,556 man-hours and $633,860 in parts costs for repairs to those units of the AN/SRC-20( ) family. As shown in Table 3-2, 1,445 repairs were made, and 1,183 of these (81.9 percent) involved part replacement. A total of 58.8 DDG-37 Class ship-operating years was reported for the period 1 January 1970 through 31 October 1976, which corresponds to an average of 24.6 repairs per ship-operating year. The AN/SRC-20( ) family experienced 1,751 days of downtime as reported by CASREPs during the period 1 July 1973 to 30 June 1976 (see Table C-2, Appendix C). Of this downtime, approximately 29 percent was attributable to maintenance and 71 percent to supply. As shown in Table B-1 (Appendix B), those parts most frequently replaced were tabulated and compared with the parts usage data for the AN/SRC-20( ) family installed on FF-1052 Class ships. Usage trends were similar for these equipments in both classes of ships.

Specific equipment problems included the centrifugal fan located within the AN/URC-9( ) transmitter cabinet that showed this part to be a high replacement item. In the FF-1052 Class a recommendation was made with respect to annotation of MRC 85 BGG2 N to alert the technician that the entire assembly need not be replaced if a failure occurred in the speed increaser. In addition, a recommendation was made to develop standards for use in determining the need for replacement of the blower assembly or speed increaser. Further investigation by the Naval Electronic Systems Command revealed that a previous action (installation of a decal on the assembly) had obviated the need for this recommendation and that existing instructions made the development of standards unnecessary. These actions satisfactorily resolve the problems experienced under normal operations. However, during periods of abnormally high operations, the speed of the

cooling fan can decrease and failure can occur before degraded performance is detected. This degradation of performance to the point of failure appears to occur at a shorter interval than that specified for periodic lubrication. Increasing the frequency of strobing would assist in preventing this failure, but it also increases the Ship's Force labor burden and exposes the unit to damage from more frequent handling. Therefore, it is recommended that a low-rpm warning alarm should be developed and installed as a field change. Informal liaison with NESEC personnel indicated that development of such a field change is within their capability.

3.3.2 Recommendations

Those recommendations developed for the FF-1052 Class for the AN/SRC-20( ) should be implemented and applied to the DDG-37 Class. The following is a restatement of those recommendations provided in the FF-1052 Class SMA:

- Task NAVELEX (NESEC, Norfolk) to design an alarm that will indicate when the speed increaser slows to less than 7500 rpm.
- For the long term, it is recommended that ships entering or in an EOC receive priority in the installation of available redesigned assemblies. (The NAVELEX equipment acquisition manager reported that a manufacturer is currently under contract to redesign the RF and PA, FMO, and audio amplifier assemblies).

3.4 AN/WRC-1( ) FAMILY OF RADIOS

The AN/WRC-1( ) family of radios (see Figures A-2 through A-4, Appendix A) consist of the AN/URT-23( ) transmitter, AN/URT-24( ) transmitter, R-1051( ) receiver, and AN/URA-38( ) antenna coupler. When the R-1051( ) receiver is used in conjunction with the AN/URT-24( ) transmitter, it is designated the AN/WRC-1( ) transceiver. A typical ship of the DDG-37 Class has four AN/URT-23( ) transmitters, one AN/WRC-1( ) transceiver, twelve R-1051( ) receivers, and four antenna couplers AN/URA-38( ). Two stand-alone AN/URT-24( ) transmitters are installed only on board the DDG-42.

The AN/URT-23( ) is a 1000-watt radio transmitter covering the frequency range from 2 to 30 MHz, with the capability of transmitting single sideband (SSB), continuous wave (CW), amplitude modulation (AM), or radio-teletype frequency shift keying (FSK). It consists of a T-827( ) transmitter, AM-3924P( ) amplifier, and PP-3917 or PP-3916 power supply.

The AN/URT-24( ) is a 500-watt radio transmitter covering the frequency range from 2 to 30 MHz, with the capability of transmitting SSB, CW, AM, or radio teletype FSK. It consists of a T-827( ) transmitter and a combined amplifier and power supply AM-3007( ).

The R-1051( ) receiver provides reception of single sideband and radio-teletype frequency shift keying in the 2 to 30 MHz frequency range.

The AN/URA-38( ) antenna coupler operates in the frequency range from 2 to 30 MHz and is capable of accepting up to 1000 watts. It is the primary antenna coupler for the AN/URT-23( ) transmitters. The AN/URA-38( ) consists of a C-3698 coupler control located at the transmitter and the CU-937 coupler mounted adjacent to the antenna (35-foot whip).

3.4.1 Discussion

Table 3-1 presents a total maintenance expenditure for the AN/WRC-1( ) family of 3,680 man-hours and $560,405 for repair parts. As shown in Table 3-2, 659 repairs were made, and 469 of these involved parts replacements.

The AN/WRC-1( ) family of radios experienced 906 days of CASREP downtime during the period July 1973 through June 1976 (see Table C-2, Appendix C). Of this downtime, approximately 30 percent was attributable to maintenance and 70 percent to supply.

As shown in Table B-2 (Appendix B), those parts most frequently replaced were tabulated and compared with the parts usage for these equipments installed aboard FF-1052 Class ships. In addition, Table B-2 shows the similarity of the parts usage per equipment operating year for equipments common to both the FF-1052 and DDG-37 Class ships. The majority of modules and assemblies are repairable at the depot level. Many of the parts are interchangeable among different equipments within the family; interchangeability of these parts (modules or assemblies) is shown in Table B-3 (Appendix B).

3.4.2 Recommendations

Those recommendations developed for the FF-1052 Class for the AN/WRC-1( ) family should be implemented and applied to the DDG-37 Class. The following is a restatement of the recommendations provided in the FF-1052 Class SMA:

- Translator/Synthesizer. For the long term, it is recommended that ships entering an EOC be given priority for installation of an improved assembly as they become available. (A contract has been negotiated for a solid-state module using phase-lock-loop technology. First-article testing is currently being accomplished at the Naval Electronics Laboratory Center [NELC], San Diego.)
- Frequency Standard. For the near term, it is recommended that ships entering or in an EOC be given priority for the installation of modified frequency standards. (Narrative data indicate that many frequency standard replacements are attributable to oven failure, which keeps the frequency standard at the required temperature. The oven is on continuously even in the standby mode. NAVELEX has developed changes that permit the oven to be de-energized when equipment is in the standby mode.)

- RF Amplifier. For the long term, it is recommended that NAVELEX improve the RF amplifier assembly by using solid-state devices in lieu of electron tubes and providing these devices on a priority basis to ships entering or in an EOC.
- Final Transformer Assembly. For the near term, it is recommended that NAVELEX investigate the commercial availability of improved final transformer assemblies. (This equipment is not limited to military applications, and an improved assembly is available from commercial sources but has not been procured for Navy use.)
- DC-DC Converter. For the long term, it is recommended that NAVELEX give priority to providing a field change to the DC-DC converter to ships entering or in an EOC. (Promulgation of a field change on the basis of current work by a contractor to provide a more reliable module is imminent.)
- Wire Antenna Strain Insulators. For the long term, it is recommended that NAVELEX investigate the feasibility of backfitting the existing stock of insulators with threaded studs. In addition, future procurement of insulators should specify that threaded studs be in place when delivered.
- HF Frequency Diversity. For the long term, it is recommended that field changes or ShipAlts for ships lacking the capability to "simo-key" be designed and provided. (To provide more reliable HF communications, ships transmitting to a shore station should key two transmitters at the same time with the same intelligence but on two different frequencies. This technique is known as frequency diversity or "simo-keying" and aids in signal reception by allowing comparison and selection of the better of the two frequencies.)
- Antenna Coupler (AN/URA-38). For the near term, it is recommended that MRC 55 BEG 7 (cleaning and inspecting the antenna coupler) be rewritten to include procedures for resealing the cover in the event of pressurization loss, torque specifications from the Technical Manual, and use of a torque wrench. It is also recommended that a cautionary statement be added to prevent the use of silicone grease as a sealant.

3.5 NTDS TRANSCEIVER EQUIPMENTS

Collectively, the reported maintenance burden during the data period for the NTDS equipments, as shown in Table 3-1, was 6,711 man-hours and $1,051,281 parts cost. By spreading the labor burden over the data period, these equipments required a total of approximately 115 maintenance man-hours per ship-operating year (less than 1.2 eight-hour man-days per month per ship). This labor burden appears reasonable for these equipments, and no course of action was identified that would further reduce it.

The modular design of these electronic equipments is a major reason for the low system labor burden. Detailed review of the MDS data revealed that of the $1,051,281 parts cost recorded against the ERCS, more than 85

percent ($897,831) was expended for multi-component cards, modules, or units. Of this amount, $72,536 was expended to support the now removed AN/SRA-22( ) ($61,674) and an early version of the AN/SRC-23( ) ($10,862).

Table B-4 (Appendix B) lists the remaining system components and the significant parts usage for each. Histograms for these parts were considered and examined for trends, and no specific usage pattern was found. None of the 58 replacement parts were reported over the total data period by more than 50 percent of the ships in the class. Eight parts are common to more than one equipment, but this interchangeability was not examined since specific usage after receipt on board ship could not be ascertained. It should be noted that the parts cost for multi-component cards, modules, and units are inflated since the MDS reflects replacement cost dollars in lieu of repair cost dollars. Repair costs for modules returned for repair are, according to NAVELEX, approximately 1/10th of the replacement costs. Study results with respect to individual problems of NTDS equipments are discussed in the following subsections.

3.5.1 AN/SRC-16(A) and AN/SRC-23(A) Transceivers

Both the AN/SRC-16(A) and AN/SRC-23(A) transceivers are designed to transmit and receive data in the Naval Tactical Data System. Data are transferred in the HF spectrum (2 to 30 MHz) at either 1 kW or 5 kW output power. These equipments were introduced into the fleet in the late 1960s. Both transceivers are modular in design, with some of the modules being interchangeable between transceivers. *There are no* Integrated Logistic Support (ILS) plans associated with these equipments as there are for the AN/SRC-20( ) and AN/WRC-1( ) families; therefore, an exact description of module interchangeability is not readily available.

Discussion

As shown in Table 3-1, $334,270 in parts costs and 1,269 maintenance man-hours were expended during the data period for the AN/SRC-23(A). Table C-1 (Appendix C) shows that there were 39 casualty reports for this equipment from 1 July 1973 to 30 September 1976, and thirty-one of these reports indicated that the failure was attributable to the 1 kW RF power amplifier module. The Technical Manual for this equipment identified the circuit symbol of this module as 1A7A1; cross-referencing to the equipment Allowance Parts List (APL) listed the module as NIIN 111-7152. Examination of the data revealed that for all listed APLs a total of 64 modules had been ordered during the data period. Two representative SECAS reports (DDG-3. and DDG-46) suggest that typically two AM-3790/SRC-23 equipments containing these modules are installed on board ships having an AN/SRC-23(A) system. It is estimated that for the DDG-37 Class there would be approximately 75 total ship-operating years for these modules, or 1.2 ship-operating years per replacement. This replacement index is not unreasonable since the equipment is not a solid-state design and is normally in one of three operating conditions: standby, tune, or transmit/receive. In addition, Table C-2 (Appendix C) indicates that the AN/SRC-23(A) experienced a total of 2,061 days of equipment downtime, and 68 percent of this was attributable

to supply support. Therefore, it is apparent that the primary reason for CASREP generation has been the insufficiency of on-board replacements for power amplifier modules.

From Table 3-1, the AN/SRC-16( ) accounted for $82,732 in parts cost and 327 maintenance man-hours from 1 July 1970 to 1 October 1976, and three CASREPs were reported for the AN/SRC-16( ) from 1 July 1973 to 30 September 1976. As detailed in Table C-1 (Appendix C), these failures were attributed to malfunctions of three different modules. Analysis of casualty and maintenance data indicated that individual part failures have been random and have not been excessive.

During discussions with NAVELEX and NESEC, Norfolk technical personnel, it was learned that the state of the art in electronic equipment design has overtaken the AN/SRC-16( ) and AN/SRC-23( ) equipments. The majority of modules in these equipments use vacuum tubes and electromechanical switches. In the limited instances where transistors are used in these equipment modules, the transistors are made of germanium, a type no longer being actively manufactured and marketed. In their continuing effort to extend the functional life of these equipments, NAVELEX is in the process of procuring limited quantities of various solid-state modules for installation as needed. In a further effort, NOS, San Diego personnel are in the process of modifying AN/URT-23( ) HF transmitter and R-1051( ) HF receiver equipments as possible replacements for the current system. The exact status of this modification effort is unknown; therefore, rapid and successful accomplishment is doubtful.

The improvement actions currently in progress by NAVELEX are considered to be items that will reduce future maintenance requirements for the AN/SRC-16 and AN/SRC-23 series of equipments. For the long term, improving the RF power amplifier of the AN/SRC-23 series and increasing the on-board spares allowance should be considered.

Recommendations

For the near term, it is recommended that the on-board allowance for the RF power amplifier module (2H 5820-00 111 7152) should be increased by one on DDG-37 Class ships.

For the long term, it is recommended that a redesign study should be authorized for the RF power amplifier module. If improvement is found to be technically and economically feasible, then implementation should be accomplished on a priority basis.

3.5.2 AN/SRA-22( ) Antenna Coupler

From Table 3-1, the AN/SRA-22( ) accumulated 782 maintenance man-hours for repair and $64,349 in parts cost during the data period, which appeared to be a significant EOC problem area. However, further data analysis indicated that 320 man-hours were for equipment installation on the DDG-44, reducing the actual maintenance man-hours to 462. Although this alone would reduce the average man-hours per equipment operating year to 6.3,

review of the maintenance narratives revealed that most of the remaining maintenance burden is associated with the conversion of the AN/SRA-22( ) (i.e., equipment is frequently replaced when failure occurs). In addition, it was learned from Ship Alt DDG 37-1089K that upon installation of the AN/URT-23( ) and its associated AN/URA-38( ) antenna coupler, the AN/SRA-22( ) is being removed. Discussions with the AN/WRC-1( ) family acquisition manager confirmed that AN/SRA-22( ) is being removed from the equipment inventory of the DDG-37 Class; therefore, recommendations for improvement are not considered to be warranted.

3.5.3 AN/SRC-31(B) Transceiver

The AN/SRC-31(B) transceiver operates in the 225 to 400 MHz range with output power of 1000+ watts for transfer of NTDS data. It is the primary equipment for operation of NTDS link 4 (ship/air/ship) and has been in the fleet since the late 1960s.

As shown in Table 3-1, the AN/SRC-31(B) has generated $238,064 in parts cost and 2,512 man-hours for repair from 1 January 1970 through 31 October 1976. From Table C-1 (Appendix C), 16 CASREPs have been reported for the AN/SRC-31(B), and no particular component is identified as the primary reason for failure of the AN/SRC-31(B) equipments. From examination of the MDS data, it was found that 99 repairs were made to the AN/SRC-31(B), of which 71 (approximately 72 percent) were repairs requiring parts.

During discussions with technical personnel of the Naval Electronics Systems Test and Evaluation Detachment (NESTED), it was learned that extensive field changes have been applied to AN/SRC-31(B) since 1973. These field changes have kept the equipment up-to-date with state-of-the-art design, and equipment maintenance is not currently a significant burden to the ERCS. Examination of the data did not conclusively validate a major downward trend in parts usage, although there is a discernible reduction. Because of the lag between change authorization and actual modification installation, it is concluded that additional time (data collection) will be necessary before a determination can be made with respect to current equipment reliability. Recommendations for further improvement are not currently warranted.

3.5.4 CU-1169, CU-1559, and AN/SRA-34( ) Antenna Components

Three of the NTDS antenna components -- the CU-1169, part of the AN/SRC-16( ); the CU-1559, used with the AN/SRC-31( ); and the stand-alone AN/SRA-34( ) exhibited a random pattern of failures. Associated maintenance narratives confirmed that failures were sporadic and of different characteristics. Therefore, no basis for recommendations was found in relation to these units.

3.6 VHF EQUIPMENT - AN/VRC-46(V)( ) TRANSCEIVER

From Table 3-1, the AN/VRC-46(V)( ) accumulated 1,614 maintenance man-hours and $1,930 parts cost for repair during the data period. Further examination of the data showed that 1,204 man-hours for equipment

installation were incorrectly attributed to equipment maintenance and repair in 1971. By reducing the total maintenance man-hours to eliminate equipment installation efforts, only 410 corrective maintenance man-hours remained, which corresponds to an average of 11.6 man-hours per equipment operating year. After 1971, failures were random without discernible trends. Since the AN/VRC-46(V)( ) currently is not a major maintenance burden, recommendations for improvement are not warranted.

3.7 OTHER EQUIPMENT

During the initial problem definition process, equipments are screened according to the maintenance man-hours and part-replacement dollars reported against their associated APL numbers during the data period; they are then ranked by their reported maintenance burden. For this analysis, the burden-producing equipments were summed in descending order until more than 80 percent of the burden had been accumulated to ensure that the major burden-producing equipments would be addressed. Table 3-1 is a summary of these equipments. Analysis of the part-usage data for these equipments and review of an MDS narrative did not disclose any significant problem areas. Therefore, it is concluded that none of the ERCS components listed in the "Other Equipment" category of Table 3-1 contributed significantly to the corrective maintenance burden of DDG-37 Class ships during the data period. No further analysis of these equipments was conducted, and no recommendations are warranted.

3.7.1 Reporting Anomalies

The equipment contributing the largest average man-hour per equipment operating year in the "Other Equipment" category is the AN/SRA-57( ) antenna coupler. Reporting anomalies were discovered during the data review for this equipment. For example, 1,000 man-hours were charged against the AN/SRA-57( ) APL for repair and replacement of transmission line sections. In a second example, 335 man-hours were charged against AN/SRA-57(A) for "unknown" reasons. For comparison purposes, the next highest single job labor burden reported for this equipment over the data period was 31 man-hours. Subtracting 1,335 man-hours from the total man-hour burden of 1,538 results in a total of 203 man-hours over the data period, which corresponds to a burden of 4.7 man-hours per ship-operating year and is not considered excessive.

3.7.2 Critical Equipment List

Several equipments were identified in the DDG-37 Class critical equipment list that have not been addressed previously. The following list presents these equipments and the rationale for their not appearing in the requisite tables and associated discussion.

Equipment	Discussion
AN/GRC-27( )	All equipments in the class have been removed and replaced by the AN/SRC-20( ) family.

(continued)

Equipment	Discussion
AN/URD-4( )	The radio direction finder was not directly associated with exterior communications, primarily due to its operational function as an aid to air controllers in CIC and therefore was not included in the equipment boundaries.
AN/SRC-16( )	The basic unit is no longer installed in the DDG-37 Class.
AM-3799/SRC-23(V) AN/PRC-41 SB-863/SRT	These equipments have not accumulated sufficient repair-parts dollars to warrant further analysis.

3.8 SYSTEM-RELATED PROBLEMS

3.8.1 Module Availability

Fleet and technical personnel reported and analyses substantiated that a problem associated with ERCS equipments is the limited availability of replacement assemblies and modules. Technical personnel indicated that up to three months can be required to receive some replacements under normal supply procedures and that only requisitions submitted under CASREP status are normally filled within ten days. Data for DDG-37 ERCS equipments in a casualty status show that approximately 68 percent (3,934 days) of the 5,811 days of reported downtime resulted from awaiting parts during a 3-year period (see Table C-2, Appendix C). For the FF-1052 Class ERCS equipments, 54 percent (10,885 days) of the 20,169 days of reported downtime was attributed to supply support during this same period.

To an extent, this problem is inherent to the modularization concept; space and cost considerations force decisions that limit replacement availability. This limitation is, however, mitigated by requiring the return of faulty items, which are then refurbished and again entered in the supply system. A principal reason for current shortages of replacement items is the amount of time items are out of the system awaiting or undergoing repair. One factor affecting this out-of-the-system time is the return of items (for refurbishment) because their status is unknown. This occurs when several items have been employed while corrective maintenance is in progress, but only one eventually proves to be faulty. Ship's Force, feeling uncertain as to the condition of the remaining items, will commonly turn them in to supply and requisition replacements in preference to retaining what they consider to be doubtful parts. Thus items that are not faulty become elements in the refurbishment cycle. The frequency of this occurrence is unknown, but informal discussions with technicians suggest that more than 20 percent of the items turned in may not be faulty.

Recommendations

The following long-term actions are recommended:

- A study should be initiated for determining to what extent ERCS assemblies and modules that are not faulty are being returned to supply by Forces Afloat for refurbishment.
- Investigate the cost-effectiveness and technical feasibility of installing shop facilities on destroyer tenders for the purpose of identifying nonfailed modules and assemblies turned in for refurbishment prior to shipment to the refurbishment facility.

3.8.2 Ship-Wide Bonding and Grounding

Discussion

Equipments located topside on board ship are exposed to corrosive elements and radiation from a ship's transmitting antennas. Consequently, special grounding is essential to reduce hull-generated intermodulation causing electromagnetic interference (EMI). Fleet and technical personnel stated that EMI was routinely reduced through proper bonding and grounding on installation of electronics equipment. However, other items, such as ladders, winches, lifelines, etc., were not checked periodically for bonding and grounding. The Baseline SARP for the DDG-37 Class BOH does not include an inspection of the ship for satisfactory bonds and grounds. MIL-STD-1310C directs that only metallic-hull surface ships, with six or more HF transmitters installed, are to have EMI reduction requirements pertaining to bonding of masts, boom and boat davits, ladders, lifelines, etc. Requirements for EMI reduction and related personnel safety for other metallic-hull surface ships are more limited when less than six HF transmitters are installed.

Recommendation

For the near term, to provide acceptable EMI conditions throughout the extended operating cycle, it is recommended that DDG-37 Class ships meet the bonding and grounding requirements specified in MIL-STD-1310C for surface ships with six or more HF transmitters installed. It is further recommended that an inspection for effective bonding and grounding be performed at POT&I and that repairs be completed at BOH.

3.9 MAINTENANCE STRATEGY

A combination of strategies are now in use for ERCS equipments: clean, preserve, and lubricate on a scheduled basis; periodically conduct performance tests and, as necessary, restore to a given functional level; and for various "go/no-go" or noncritical items, run-to-failure and "fix or replace" when failure occurs. The analysis confirmed that current practices are effective and preventive measures are adequately implemented by the current PMS.

Many of the ERCS equipments are modularized, and system repair consists of the replacement of faulty modules with the failed item being turned in for depot-level refurbishment. Therefore, modules receive the equivalent of a Class "B" Overhaul after each failure.

A scheduled periodic overhaul strategy is not in force for ERCS units and does not appear necessary or desirable. When equipment overhaul is required, it is usually accomplished during a shipyard availability or during the operating cycle with IMA assistance.

3.10 BASELINE OVERHAUL REQUIREMENTS

The Baseline Overhaul concept of the NAVSEA 934 EOC program is designed to accomplish the maintenance actions that are necessary to restore a ship to a condition in which, with a well engineered and executed maintenance program, it can be expected to perform satisfactorily over an extended operating cycle. No additions or deletions to the Repair Requirements for BOH (DDG-37 Class) dated November 1976 are warranted as a result of this analysis. However, it is recommended that equipments within SWBS 415 (digital data communications) and SWBS 441 (radio systems) items 1, 4, 5, 6, 7, and 9 should be subjected to inspection, with a Class B Overhaul assessed on the basis of the individual equipment's condition as a result of POT&I. SWBS 441 items 2 and 3 are scheduled for replacement by ShipAlt DDG-37-1089K, as indicated in Appendix D. If this ShipAlt is not accomplished, then items 2 and 3 should be provided with a Class B Overhaul. SWBS 441 item 8 (AN/URA-38, antenna coupler) should be provided with a Class B Overhaul because of its continuous exposure to the sea environment.

NAVELEX-authorized design improvements and modifications are accomplished by field changes. NAVELEX has an ongoing project that provides manpower and materials to install outstanding field changes, throughout the operating cycle, which are beyond the scope of Ship's Force. Accomplishment of field changes is not expected to impact the Baseline Overhaul.

3.11 INTRA-CYCLE AND FOLLOW-ON ROH REQUIREMENTS

Ship's Force personnel, assisted by the various IMA contingents (AD, MOTU, SIMA) have the capability to perform major maintenance actions on the ERCS equipments. Maintenance actions that cannot be handled by these means usually result from unpredictable catastrophic failures. Therefore, the only intra-cycle maintenance requirements expected are the existing preventive PMS actions and corrective actions that are within the scope of current Ship's Force and IMA capabilities.

Follow-on ROH requirements should be determined for individual ships on the basis of pre-ROH tests and inspections.

CHAPTER FOUR

CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Significant conclusions resulting from this Review of Experience are as follows:

- A majority of the equipments constituting the DDG-37 Class ERCS are the same as those of the FF-1052 Class; therefore, action is being taken to implement most of the recommended reliability and maintainability improvements listed in Table 4-1, resulting from the previous FF-1052 Class ERCS SMA.
- A majority of the operational inadequacies and repetitive circuit failures relating to NTDS equipment have been identified by equipment acquisition and maintenance managers for redesign or improvement; NAVELEX action is under way to correct these deficiencies.
- Major ERCS equipments primarily consist of an integration of units, most of which are modularized. Depot-level repairable modules are in short supply for some units because of long turnaround times while undergoing repair.
- Decisions to overhaul units of the ERCS should, by current NAVELEX policy, depend on inspection and testing rather than on a predetermined schedule.
- A combination of maintenance strategies are now in use for ERCS equipments. Essentially, these strategies are (1) clean, preserve, and lubricate on a scheduled basis; (2) periodically conduct performance tests and, as necessary, restore to a given functional level; and (3) for various "go/no-go" or noncritical items, run-to-failure and "fix or replace" when failure occurs. The analysis confirmed that current practices are effective, and preventive measures are adequately implemented by the existing PMS.

4.2 RECOMMENDATIONS

Corrective actions and planning activities identified by this ROE are categorized as follows:

- Baseline Overhaul Requirements

- Intra-Cycle Maintenance Requirements
- Follow-On ROH Requirements
- Reliability and Maintainability Improvements
- IMA Improvements
- Depot-Level Improvements
- PMS Changes
- Integrated Logistic Support (ILS) Improvements

Specific recommendations from this Review of Experience are summarized in Table 4-1. All recommendations resulting from this analysis are summarized in the DDEOC Action Table presented in Appendix E.

Table 4-1. SUMMARY OF ROE RECOMMENDATIONS FOR THE DDG-37 CLASS EXTERIOR RADIO COMMUNICATIONS SYSTEM (ERCS)

Component	Recommendation
Baseline Overhaul Requirements	
Bonding	Inspect for proper bonding at POT&I; correct during BOH.
Overhaul status of digital data communications (SWBS 415) and radio systems (SWBS 441)	Change Repair Requirements for BOH (DDG-37 Class) from "requirement" to "reservation"; include all equipment in POT&I.
Intra-Cycle Maintenance Requirements	
Scheduled restorative maintenance will not be required during the intra-cycle.	
Follow-on ROH Requirements	
Follow-on restorative maintenance should be accomplished as shown to be necessary by the ship's CSMP and POT&I results.	
IMA Improvements	
Destroyer tender test facilities	Depending on the results of the ILS recommendation with respect to supply support, investigate the technical feasibility and cost-effectiveness of installing shop facilities for testing critical items.
PMS Changes - None.	
Reliability and Maintainability Improvements	
AN/SRC-20( ) Family	
RF and PA, FMO, and Audio Amplifier Modules*	Install solid-state modules, as available.
Centrifugal Fan and Speed Increaser	Design and develop low-rpm alarm field change.
AN/WRC-1( ) Family	
Translator/Synthesizer*	Provide replacement solid-state modules, as available.
Frequency Standard*	Give priority to providing modified modules.
RF Amplifier*	Provide solid-state module.
Final Transformer Assembly*	Provide improved commercially available modules.
DC-DC Converter*	Provide field change to improve module.
Wire Antenna Strain Insulators*	Procure and backfit insulators with grounding strap stud in place.
Simo-Keying HF Transmitters*	Develop field change or ShipAlt to permit simo-key operation.
NTDS	
AN/SRC-23( ) RF PA Module, NIIN 111-7152	Investigate feasibility of redesigning RF PA module to incorporate solid-state technology.
Integrated Logistic Support Requirements	
AN/SRC-23( ) RF PA Module, NIIN 111-7152	Increase on-board spares allowance from one to two.
Supply Support	Initiate a study for determining to what extent the ERCS repairable assemblies and modules not in need of repair are being returned for refurbishment.

*Also recommended in the FF-1052 Class ERCS SMA.

LIST OF REFERENCES

The following selected references were used as the basis for the Review of Experience of the Exterior Radio Communications System:

1. Generation IV MDS Part and Maintenance Data for DDG-37 Class, January 1970 through 31 October 1976.
2. CASREP Narrative Summaries, 1 July 1973 through 30 June 1976.
3. Ship Equipment Configuration Accounting System (SECAS) Report for DDG-37 and DDG-42.
4. Allowance Parts List (APL) for selected components of the Exterior Radio Communications System.
5. Electronics Information and Maintenance Books (Communications), NAVSHIPS 0967-LP-000-0010, March 1976.
6. Ship Alteration Information Manual, DDG-37 Class, 30 June 1976.
7. NAVELEX Instruction P4110.45, April 1975 (ILSP for AN/WRC-1 Family).
8. NAVELEX Instruction P4110.55, November 1974 (ILSP for AN/SRC-20 Family).
9. Shipboard Antenna Systems, Volume 2, NAVSEA 0967-LP-177-3020.
10. Shipboard Bonding, Grounding and Other Techniques for Electromagnetic Compatibility and Safety, MIL-STD-1310C (SHIPS), 30 November 1973.
11. Test Equipment Index, NAVSEA 0967-LP-008-9000, February 1977.
12. DDEOC Repair Requirements for BOH (DDG-37 Class), July 1977.
13. Visits to ships and technical organizations in Norfolk, Virginia, and Charleston, South Carolina, 25 July - 5 August 1977.
14. Technical Manual, Radio Transmitting Set, AN/URT-23, NAVSHIPS 0967-191-7010, 15 April 1967.
15. Technical Manual, Radio Transmitting Set, AN/URT-23A, NAVSHIPS 0967-456-9010, 1 January 1974.
16. Technical Manual, Antenna Coupler Group, AN/URA-38, NAVSHIPS 0967-204-0010, 1 February 1971.
17. Technical Manual, Radio Sets, AN/SRC-20/21, NAVSHIPS 0967-125-6010, 1 March 1967.

18. Technical Manual, Radio Set, AN/WRC-1, NAVSHIPS 0967-971-0010, 4 February 1964.

19. Technical Manual, Receiver Set, Satellite Signal, AN/SSR-1( ), NAVSHIPS 0967-LP-541-9010, 1 April 1967.

20. Technical Manual, Radio, AN/URC-9A, NAVSHIPS 0967-378-3010, 13 March 1970.

21. Technical Manual, Antenna Coupler Group, AN/SRA-33, NAVSHIPS 0967-037-8000, 12 May 1966.

22. Technical Manual, Satellite Communications Set, AN/WSC-3, NAVELEX 0967-LP-545-4050/4060/4070, 15 May 1975.

23. Technical Manual, Radio Set, AN/SRC-16A, NAVSHIPS 0967-LP-086-3010 through 3050.

24. Technical Manual, Radio Set, AN/SRC-23A, NAVSHIPS 0967-LP-163-9010 through 9070.

25. Technical Manual, Radio Set, AN/SRC-31A, NAVSHIPS 0967-237-9010 through 9050 and NAVSHIPS 0967-LP-427-1010.

26. Technical Manual, Antenna Coupler, AN/SRA-34A, NAVSHIPS 0967-176-3010.

APPENDIX A

BOUNDARIES OF THE EXTERIOR RADIO COMMUNICATIONS SYSTEM

This appendix presents the boundaries of the Exterior Radio Communications System as defined in this analysis. Table A-1 lists the major components, and quantity of each, found on each ship. In developing this table, an attempt was made to resolve inconsistencies among Type Commander's COSAL and MDS reporting data, but all such inconsistencies could not be resolved. This configuration is the best estimate from all available data sources. Descriptions of major radio equipments are shown in Tables A-2 and A-3.

Figure A-1 illustrates the AN/SRC-20( ) family configuration. Figures A-2 through A-4 show the configuration of the three most common HF equipments -- AN/WRC-1( ), AN/URT-23(V), and AN/URT-24( ).

Table A-1. COMPONENTS OF THE DDG-37 CLASS EXTERIOR RADIO COMMUNICATIONS SYSTEM

Nomenclature	SWBS	EIC	APL/CID	Quantity by Hull Number									
				DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
ANTENNAS & MATCHING DEVICES													
ANTENNA, GENERAL PURPOSE													
AS-1018/URC	441	Q11D	59201800		2	2	2	5	5	2	4	2	2
AS-2537/SR		Q157	59309931										3
AS-2337/SR Dual Whip			-										1
AS-2337/SR Twin Tilt			-										1
AS-2865/SRC Bow Stub		-	3049530PB							1			
AS-2866/SRR		Q161	30495103PB	1	1	1	1					1	1
AS-390A/SRC		Q114	59139000SA	2		1	2					2	3
AT-150/SRC		Q11T	59365000					6	7	3	1		
AT-252/SR		Q11U	57100800FE					1			1		
AT-924/SR		Q13G	57100800FA	3					3				
AT-924A/SR		Q13H	57100815FA		1					2		1	
AT-924B/SR		Q13U	10000977NA	1	3	4	4			2		2	4
AT-1082/SR		Q13L	10000977NA						2				
AT-1047/U		Q13V	59434700		1		1			1			
66047		Q105	06604700	4	4	4	4	6	8	4	8	4	
66047 Twin			06604700PD	2	2	2	2			2		2	
66047 Trussed			06604700PC	1									
66047 Mod			06604700PE			1	1					1	
66095		Q107	06609500	2	1	1	1	1	2	2	1	1	1
COUPLERS/MULTICOUPLERS													
AN/SRA-19		Q91H	57101095							1			
AN/SRA-22		Q91K	57101400SL					4	3		3		
CU-74/SRA-22		-	62687501					4	3		3		
AN/SRA-33		Q91Q	57102300	1	1	1	1			1	4	1	3

(continued)

Table A-1. (continued)

Nomenclature	SWBS	EIC	APL/CID	Quantity by Hull Number									
				DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
COUPLERS/MULTICOUPLERS (Continued)													
AN/SRA-34(A)V	441		57102334CL	2	2	2	2			1	1	2	1
AN/SRA-49		Q91Z	57102347						1				
CU-1799/SRA		-	62692276						6				
AN/SRA-50		Q930	57102348	1	1	1	1		1	1	1	1	1
CU-1800/SRA		-	62692277	6	6	6	6		6	5	6	6	6
CU-1801/SRA		-	62692278	4	4	4	4		3	5	4	4	4
CU-1802/SRA		-	62692279	4	4	4	4		4	4	4	4	4
PP-4846/SRA		-	79738775	1	1	1	1		1	1	1	1	1
AN/SRA-57		Q934	57102357	1	1	1	1			1	1	1	1
AN/SRA-58		Q935	57101358	1	1	1	1			1	1	1	1
AN/URA-38		Q94F	58433800	3			2					2	2
AN/URA-38A		Q94T	58433801		2	2				2	2		
CU-691/U		Q93Q	62687400	1	1	1	1			1	1	1	
CU-937/UR		Q93Y	2688437		1	1	2	1	3	3	1	1	1
CU-937A/UR		-	62692288	1									
C-3698 P/O URA-38				3	2		2						
C-3698A P/O URA-38						2					2	2	
FILTER ASSEMBLY - RECEIVING													
AN/SRA-12		Q90Q	57043600		1	1		1		1	1		
AN/SRA-12A		Q90R	57100301	1			1	2					
AN/SRA-12B		Q90S	57100310	1					2				
AN/SRA-12C		Q90T	57100315									1	
ANTENNA GROUPS													
AN/SRA-3		Q10Z	57042700					1					
AN/SRA-17		Q919	57100800	3	1	1		1	2	1		1	
AN/SRA-17A		Q91A	57100805		1			1					
AN/SRA-17B		Q91B	57100810			2	3			3	3	2	1

(continued)

Table A-1. (continued)

Nomenclature	SWBS	EIC	APL/CID	Quantity by Hull Number									
				DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
FILTER ASSEMBLY - RECEIVING (cont)													
AN/SRA-17C	441	Q91C	57100815	1	2	1	1	1	1		1	1	3
AN/SRA-43		Q91Y	57103223	6	6	6	6		2	6	6	6	6
ANTENNA TILT ASSY'S													
Controller AC MAG SZO		-	151903400	1	1	1	1		1	1	1	1	
Motor AC 2HP		-	174800067		1	1	1		1	1	1	1	
Motor AC 2HP		-	175501402	1									
Switch Assy. 4 Element		-	211000335				1						
Switch Assy. 3 Element		-	212102133						1				
Switch Assy. 4 Element		-	212102830		2	2	1			2	2	1	
Switch Assy. 4 Element		-	212104090						2				
Switch Assy. 3 Element		-	212900311	2									
Switch LMT 5 ML1		-	213190279	3	3	3	3			3	3	3	
Light IND B-46B		-	239990038	2			3			3	3		
Light IND B-46A		-	239990055	3								3	
Gear Assy. Spd Decr Aux 600-1		-	692010025	1	1	1	1		1	1	1	1	
Coupling Shaft		-	780220026	1	1	1	1		1	1	1	1	
Switch Assy. 3 Element		-	212900495									1	
TRANSMITTER GROUPS													
MF/HF													
AN/CRT-3		QEOD	54390900	3	3	3	3	1	3	3	3	3	3
AN/CRT-3(A)			54390901					2					
AN/URT-23(V)		QE1N	58557823	6	6					4			4
PP-3916/UR		-	79737900	6	6					4			4
AN/URT-24(V)		QE1P	58557824						2				
AM-3007/URT		-	52300700						2				

(continued)

Table A-1. (continued)

Nomenclature	SWBS	EIC	APL/CID	Quantity by Hull Number									
				DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
MF/HF (continued)													
AN/WRT-2	441	QE1W	59010200 59010201		0	3	2	1	2	0	3	3	0
UHF													
AN/URT-7C		QE1J	58556509	1	1	1		1	1		1	1	1
AN/URT-7D		QE1K	58556515				1			1			
RECEIVER GROUPS													
VLF/LF/MF													
AN/SRR-13A		QBOT	57141001		1								
AN/SRR-19		QBOU	57141319				1			1		1	
AN/SRR-19A		QBOY	57141318		1			1	1		1		
AN/SRR-19B		QB4Q	57141318SA	1		1							1
AN/WRR-3A		QB1H	59005301			2			1				2
AN/WRR-3B		QB1J	59005302	3	3	1	3	1	1	3	2	3	1
AN/WRR-3		QB1G	59005300					1					
MF/HF													
AN/URR-44		QB1B	58536800	2	2	2	2	2	2	2	2	2	
R-1051/URR		QB38 QD4T	81095100	1	2		3	3	2	6	2	2	4
R-1051B/URR		QB34 QD4U	81095102	10	7	10	14	8	10	4	3	10	6
R-1051D/URR		QB4N	81101551								6		2
R-1051E/URR		QB4V	81099010	1	1		1	2				1	1
R-390A/URR		QB37	81039001	3	2	2		2	2	2	7	3	
VHF													
AN/URR-27		QB14	58535100	1	1		1	1	1	1	1	1	1
AN/URR-27A		QB15	58535105			1							
UHF													
AN/URR-35C		QB1A	58535909								5		

(continued)

Table A-1. (continued)

Nomenclature	SWBS	EIC	APL/CID	Quantity by Hull Number									
				DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
UHF (continued)													
AN/SSR-1	441	QPOV	57191299	1	1	1	1	1	1	1	1	1	1
TRANSCEIVER GROUPS													
HF													
AN/SRC-16(A)			57110801CL					1	1		1		
AN/SRC-16(XN-1)													
AN/SRC-23(A)			57112303CL	2	2	2	2			1	1	2	1
AN/URC-32B		QD4K	58442106			2		1	2		3		
AN/URC-35		QD4L	58443500		1		1	1					
AN/URC-35A		QD6L	58443501							1			
AM-3007/URT			52300700 52800710	1	2	1	2	1		2	1	1	1
AM-3007A/URT			52300706			1							
C-3697/URC			61367599							1			
RT-618A/URC			84096618							1			
RT-618B/URC			84096620			1							
AN/URC-35B		QD6M	58442308			1							
AN/WRC-1		QD4T	59001100	1			1						
AN/WRC-1B		QD4U	59001105		1	1		1	1	1	1	1	1
VHF													
AN/PRC-10		QD17	56614600						2	2			
AN/PRC-10A		QD18	56614601					2					
RT-176/PRC-10			84067800					2	2	2			
AN/PRC-25		QD1C	56616100								2	1	
AN/PRC-27		QD1X	56617800	2	2	2	2			1	2	3	
AN/URC-80(V)5		QD6Z	58446701	1	1	1	1	1	1	1	1	1	1

(continued)

Table A-1. (continued)

Nomenclature	SWBS	EIC	APL/CID	Quantity by Hull Number									
				DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
VHF (continued)													
AN/VRC-46	441	QD4R	58841200					1	1				
UHF													
AN/PRC-41		QD1M	56617700	2	2	2	2	2	1	6	1	2	2
AN/SRC-20		QD3R	57112000	4	4	4	2	5	1	4	4	2	13
AN/SRC-20A		QD6H	57112002				2		3			2	
AN/SRC-21		QD3S	57112100	2	2	2	2	2	2	2	2	2	2
C-3866/SRC		QD4V	57112100FC 57112000FD 57112002FI	6	6	6	6	10	4	6	6	6	16
AN/SRC-31(A)				1			1	1		2		1	1
AN/SRC-31(B)				1	2	2	1	1	1		2	1	1
AN/URC-4		QD45	58439200CL			2	1	3	2			1	
AN/URC-4A							2						
RT-159B/URC-4			84066105	4	2	3	5	3	2	4	3	3	3
AN/URC-4B			58439200CM	4	2	1	2			4	3	2	3
AN/URC-9		QD47	58439716	4	4	4	5	2		7	1	4	1
AN/URC-9A		QD6N	58439720								3		
C-2383/URC-9			61227903					3					
AN/URC-85			58446711CL			1		1	1				
AN/WSC-5(V)		QPOA	59011030CL									1	
AN/WSC-3 ESS		QPOW	59011017									2	
AN/WSC-3(V)		QP15	59011001	1	1		1			1			1

(continued)

Table A-1. (continued)

Nomenclature	SWBS	EIC	APL/CID	Quantity by Hull Number									
				DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
SWITCHING DEVICES/CONTROLS													
C-2691/URC	441		58442100FW	5	4	4	5	4	5	4		4	4
C-2691A/URC									1				
C-3697/URC P/O URC-35			61367599				1						
C-3868/SRC		HGOE QC1B	61386810 61386800	6	9	9	9	9	2	10	7	9	7
C-4621/SR		QC1C	61397621	1	1	1	1	1	1	1	1	1	1
C-8151/U		QQ08	61399851						1	1			
MX-1986A/SRC P/O VRC-46A		QC39	75798601	1			1	2	1	1			1
SA-1499/UR		QC3A	85197929	11	9	6	6	15	10	6	4	6	17
SA-273/U Rotary		QMOM	10013444NA	2	2		2						
SA-274/U		QMON	10013445NA			1							
SA-770/UR		QC1W	61949926	4	4	4	5			2	3	4	3
SB-83/SRT		QC1Y	85208300	1			1	1				1	1
SB-863/SRT		QC33	85286300	10	10	10	9	9	9	10	10	10	11
SB-973/SRR		QC34	85293300	82	80	81	80	9	43	74	71	72	84
SB-988/SRT		QC35	85298800	4	4	5	4	1	3	8	5	4	6
SB-3332/SR			85299932	1	1	1	1		1	1	1	1	1
SB-3333/SR			85299933								1		
REMOTE TERMINATING DEVICES													
AMPLIFIERS													
AM-215/U		Q70B	52021508				1	4					
AM-215A/U		Q70C	52021501					2					6
AM-215B/U		Q70D	52021505	1	4								
AM-215D/U		Q70F	52021513	15	10	14	14	14	18	15	17	14	8
AM-3729/SR		Q70K	52357100	12	14	14	14	9	8	14	5	14	14

(continued)

Table A-1. (continued)

Nomenclature	SWBS	EIC	APL/CID	Quantity by Hull Number									
				DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
CONTROLS													
C-1138/UR	441	QC10	61113800	1	1		4						
C-1138A/UR		QC11	61113805	1		2		3	3			1	7
C-1138B/UR		QC13	61113810	14	16	14	12	20	19	19	14	12	4
C-1207/UR		QC15	61120700					1		1			
C-1207/UR		QC16	61120705	1	1	2	1		1	1	1	1	1
C-4621/SR		QC1C	61397621	1	1	1	1	1	1	1	1	1	1
TERMINAL/JACK BOXES													
J-559A/U													1
J-560/U			70029200	3	3	3	2	1				3	3
J-939/U			70036000	5				14					
J-939A/U			10012640NA			18			18		11		
J-939B/U			10012641NA	19	22	2	23	3		5		20	16
KEYING DEVICES													
SB-315B/U		QC31	85231505	2	2	3	3	4	1	3	6	2	2
LOUDSPEAKERS													
LS-474/U		M307 QUF3	72754474	11	15	14	14	11	9	20			
LS-474A/U			72754475	1	1	1	1	1	1	1		2	1
CUL-49546			04954600PA	21	17	13	20	13	20	3		10	19
HAND/HEAD/CHEST SETS/MIC's													
CTE-162D000 Headset/Mike			37895701	10	9		1						11
H-138/U			67011919									2	
H-157/AIC			67015201	3									2
H-169/U		QUDP	67016900	15	26	19	39	26	19	19	30	44	2
H-172/Y			67017200	5		1	2	5	7	6		22	5
H-186/U			67018600	7	5	1	8	1				3	7

(continued)

Table A-1. (continued)

Nomenclature	SWBS	EIC	APL/CID	Quantity by Hull Number									
				DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
HAND/HEAD/CHEST SETS/MICs (cont)													
H-189/GR	401	QM57	67017709	1	2			1				2	1
H-29B Chest Set			67021667					2					
H-3/ARR-3 Head Set			67000030		1		4					6	
H-33F/PT			67006850	1	2	2	2	5	2			5	2
M-58/U			73003361					1					
M-85/U			73008500		2			1	6			3	2
M-95A Head Set			73009703						24				
M-159/U		QM4U											1
CVA-51007A Hand Set			05100700									1	
CVA-110740			38278921PA	16	11		19						
CVA-115180 Head Set			38279820PA									2	
CVL-600E Microphone			38113400	1	1		1	1				1	
QUAL MONITOR CONT SYS (QMCS)													
AN/USM-117C			58614308	6	7	1	4	8	6	8	4	9	2
AN/USM-207 Counter		WF0T	58627021	6	5		3	1	5	10	4	8	4
AN/USM-207A		WF58	58627022	1				1	1			3	
TS-1379A/U		WQ37	92078901	2	1		1	1	2	1	1	1	
TS-1379/U		WQ1U	92078900				1						
CAQI-400E		WC1F	61610021									8	
CAQI-400H		WC1H	61610040PA	2	3			1	2	4	2	6	4
CDCU-TTG-5A			31666507PB				1						1
CPN-SSB-50-1		WQ3L	31666510							1			
CPN-TTG-3		QUDC	10017842							1			
CPN-TTG-5A		W363	31666507PA	1									
CV-2353/U SSB Converter			62762806					1					

(continued)

Table A-1. (continued)

Nomenclature	SWBS	EIC	APL/CID	Quantity by Hull Number									
				DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
QUAL MONITOR CONT SYS (QMCS) (cont)													
CV-2343A/U SSB Converter	441	W817	62762805	1	1		1		1			1	1
AN/URM-144		W30Y	58499397		1						1	1	
DEDICATED TEST EQUIPMENT													
AN/PRM-10 Grid Dip	491	W301	56661400	2				1	1	1			1
AN/URM-43A		WB05	58489901						3				
AN/URM-43B		WB06	58489905							1			
AN/URM-86A		WB33	58494087	1									
AN/URM-96A		WBOA	58495205								1		
AN/URM-120 Wattmeter		WBOB	58497610		1		1	2		1	1	2	3
CAWY-8890			10003357		2		1					1	
CAWY-BA-88			10017187		2		1					1	
CAWY-43		WBOW	37099800						1		1		
CBUW-164-FMN		WB09	58495200	1						2	1		
CBUW-185A-150 FN			61871835									1	
IM-89/UR		WC7W	69001900						2	1		2	
ME-11/U		WB1N	58489900SA						1				
ME-11A/U		WB1P	58489901SA						2				
TS-1771/U		WB1Z	92163500	1	1		1	1	1	1	1	1	
TS-1771A/U		WB1Z	92163501					1		1			1
FREQUENCY STANDARDS													
AN/URQ-10		QCOM	58532405	1	1	1	1	1		1	1		
AM-2123(V)/U		QROH	52212304CL		3		3		1	1		3	
AM-2123A(V)/U		QM03	52212301CL	4		3		2	3	2	3		3

Table A-2. DESCRIPTION OF MAJOR UHF RADIO EQUIPMENT

Major Equipment (Frequency Range) (Output Power)	Components	Name
AN/URC-9( )		Transceiver
(225-400 MHz)	MX-1743	Adapter Control
(25 Watts)	CV-691	Antenna Coupler
AN/SRC-20( )		Transceiver
(225-400 MHz)	AN/URC-9( )	Radio Set
(100 Watts)	AM-1565	High Power Amplifier
	C-3866	Remote Control Unit
	C-3868	Remote Control Indicator
	C-1138	Remote Dial Unit
AN/SRC-21( )		Transceiver
(225-400 MHz)	AN/URC-9( )	Radio Set
(25 Watts)	C-3866	Remote Control Unit
	C-3868	Remote Control Indicator
	C-1138	Remote Dial Unit
AN/SRA-33		Antenna Coupler
	CU-1131	Control Unit
	CU-1132	
	CU-1133	
	CU-1134	

Table A-3. DESCRIPTION OF MAJOR HF RADIO EQUIPMENT

Major Equipment (Frequency Range) (Output Power)	Components	Name
AN/URT-23( )		Transmitter
(2-30 MHz)	PP-3916, -3917	Power Supply
(1 Kilowatt)	T-827( )	Transmitter
	AM-3924P	High Power Amplifier
	AN/URA-38( )	Antenna Coupler
AN/URT-24( )		Transmitter
(2-30 MHz)	AM-3007	Amplifier/Power Supply
(100 Watts)	T-827( )	Transmitter
	J-1265	Interconnecting Box
	CU-937	Antenna Coupler
AN/WRC-1( )		Transceiver
(2-30 MHz)	AM-3007	Amplifier/Power Supply
(100 Watts)	T-827( )	Transmitter
	J-1265	Interconnecting Box
	R-1051( )*	Receiver
	CU-937	Antenna Coupler

*Addition of R-1051( ) to AN/URT-24 changes the nomenclature to AN/WRC-1( ).

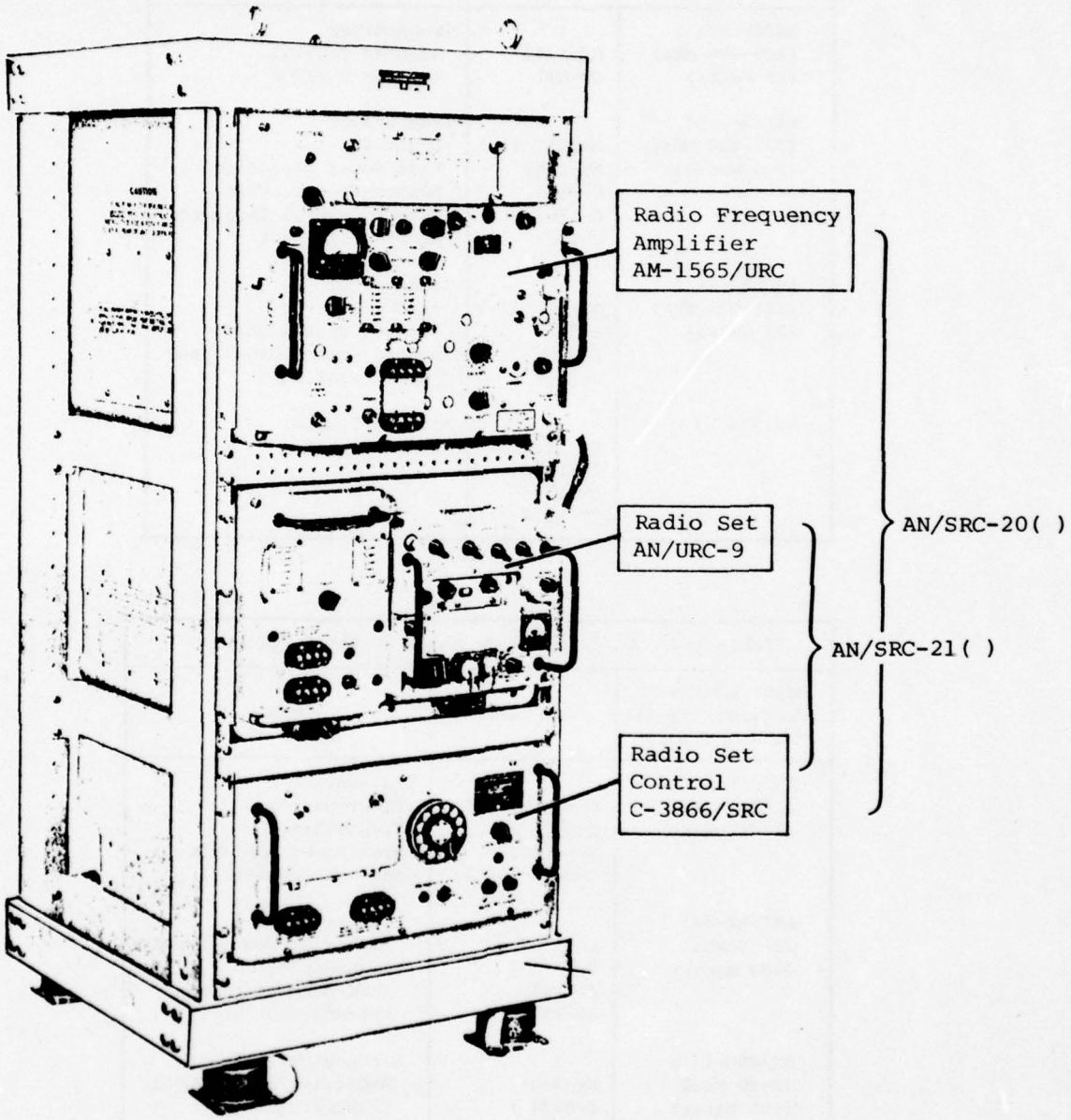

Figure A-1. CONFIGURATION OF AN/SRC-20( ) RADIO SET

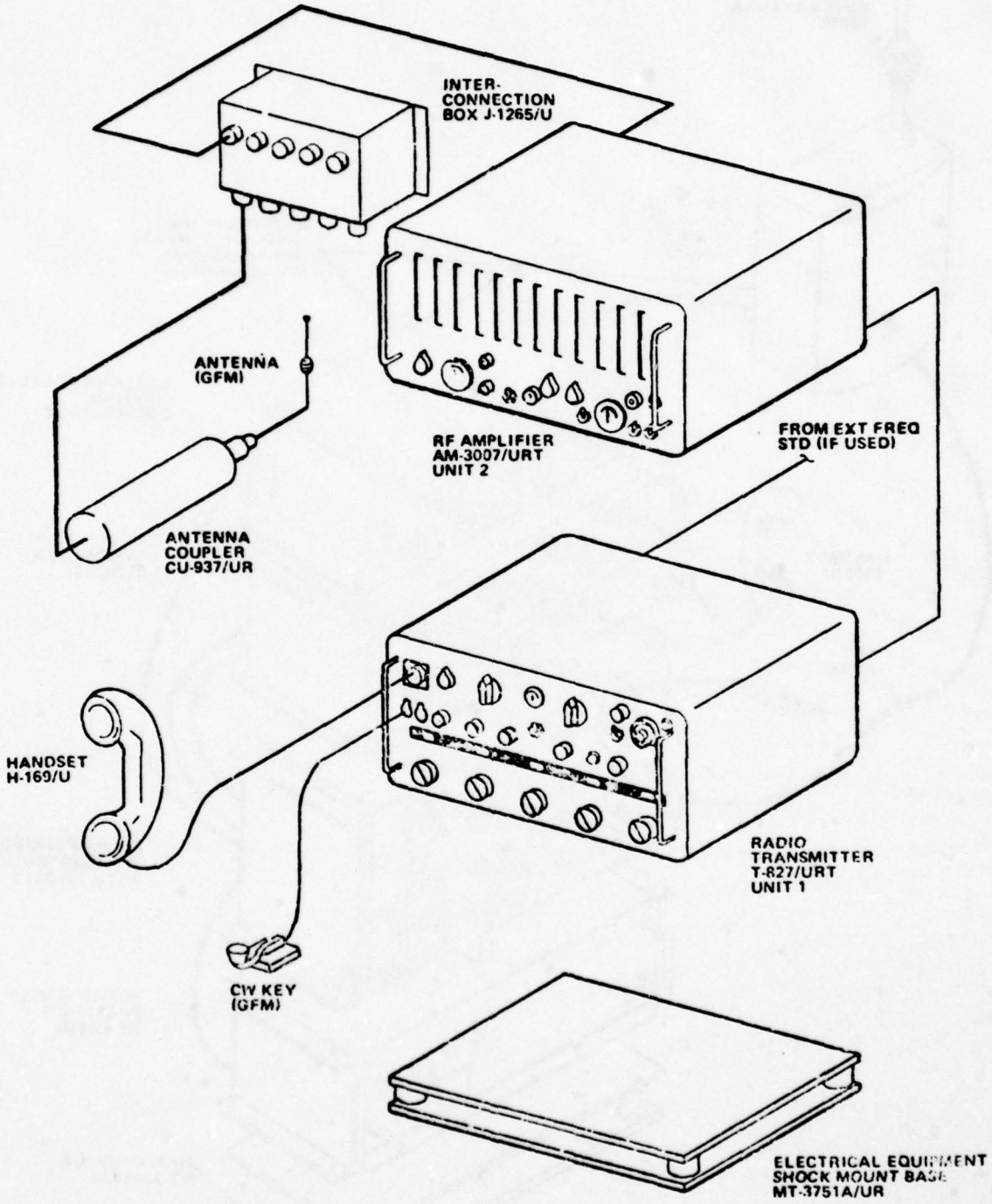

Figure A-2. AN/WRC-1( ) RADIO SET

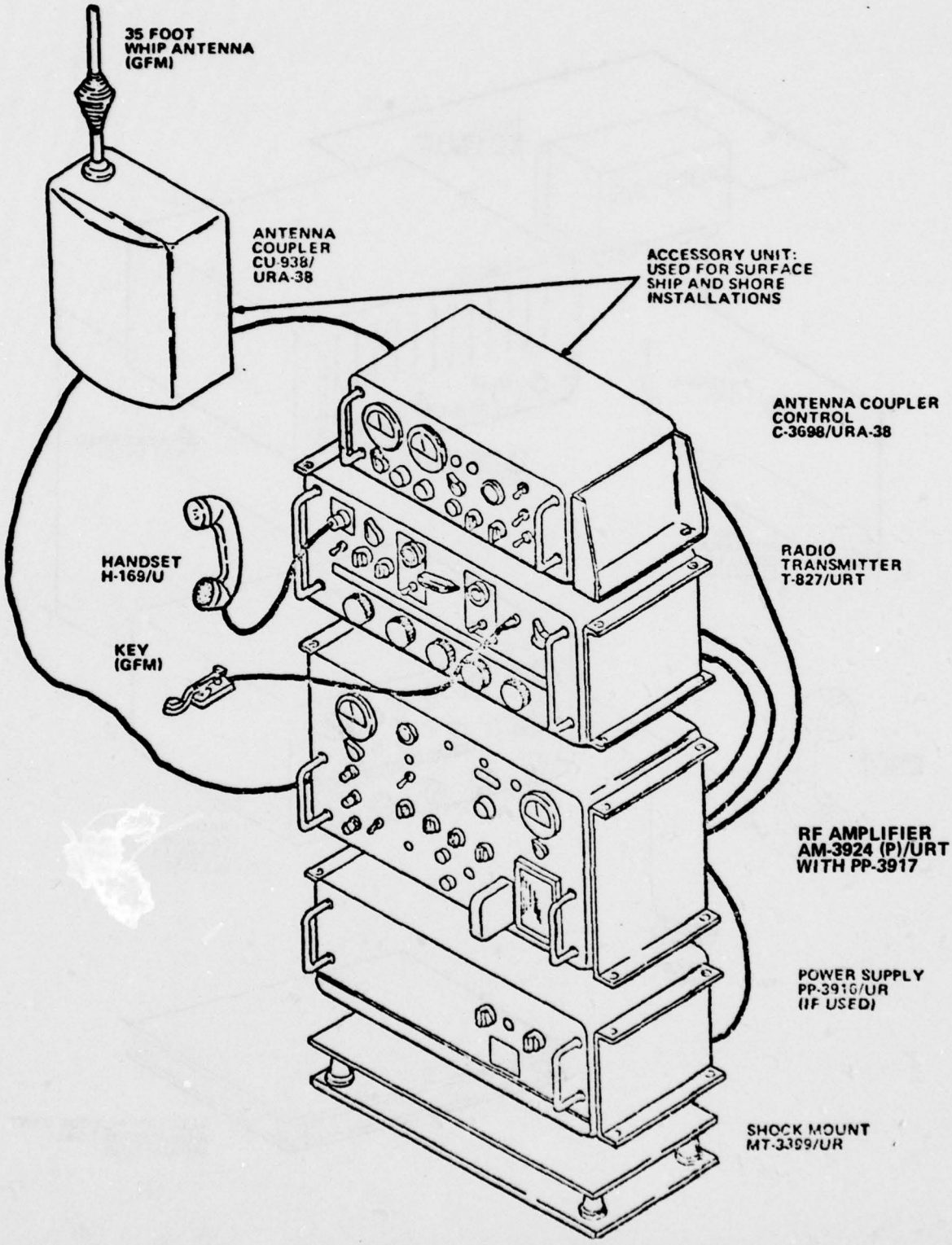

Figure A-3. AN/URT-23(V) RADIO TRANSMITTER

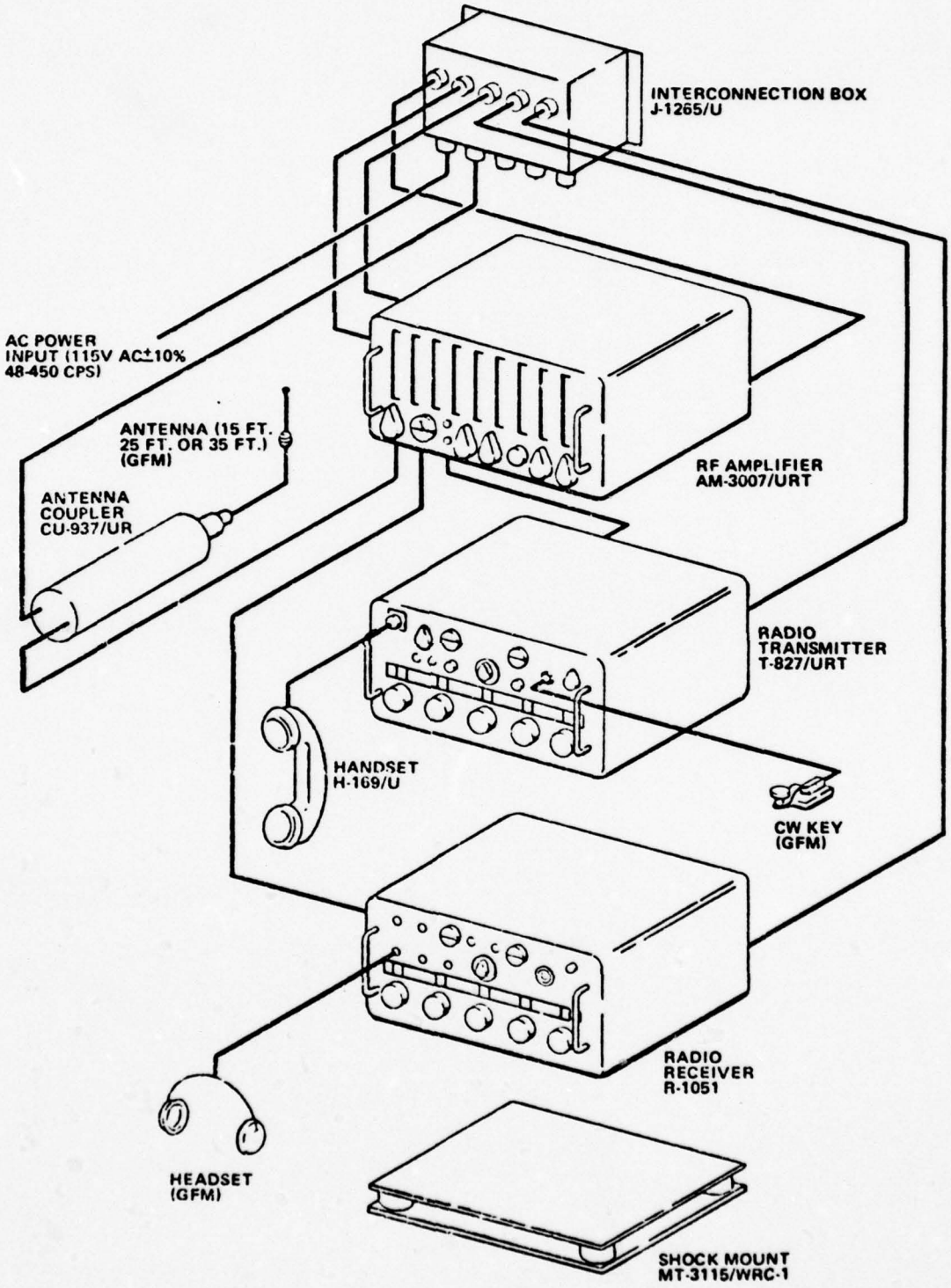

Figure A-4. AN/URT-24( ) RADIO TRANSMITTER

APPENDIX B

MDS PART USAGE DATA SUMMARY

Table B-1 of this appendix presents a listing of the significant parts related to the DDG-37 Class maintenance of the AN/SRC-20( ) family, and Table B-2 provides the same information for the AN/WRC-1( ) family. The results were derived from the screening of MDS data in accordance with the procedures described in Chapter Two. Both tables include parts usage information extracted from the data. It is assumed that the part usage shown will not continue over the period of the DDG-37 EOC, since many of the modular assemblies of the AN/WRC-1( ) family have been or will be undergoing redesign for reliability improvements. The DDG-37 Class will benefit from the newer modules by enhancing the availability of the AN/WRC-1( ) family module interchangeability. Table B-3 presents a summary of module interchangeability within the AN/WRC-1( ) family of equipments. Table B-4 lists the major NTDS replacement items that can be attributed as significant expenditures.

Table B-1. SIGNIFICANT PARTS USAGE FOR THE AN/ARC-20( ) FAMILY

Nomenclature	Equipment Part Used In	NIIN	Average Cost (Dollars)	FF-1052 Class		DDG-37 Class		Replacements per Equipment Operating Year	
				Total Parts Replacement	Ships Reporting	Total Parts Replacement	Ships Reporting	FF-1052	DDG-37
First IF Amplifier*	URC-9( )	075-0493	190	332	44	184	10	0.83	0.98
Frequency Selector*	URC-9( )	075-0495	472	161	28	89	8	0.40	0.47
Freq. Multiplier Oscillator*	URC-9( )	760-8922	288	517	46	250	10	1.29	0.33
Power Amplifier*	SRC-20( ) (AM-1565)	861-3550	2640	43	22	35	10	0.11	0.14
RF & PA Assembly*	URC-9( )	981-1598	378	1137	46	418	10	2.80	2.20
Audio Amplifer Modulator	URC-9( )	981-1599	579	49	10	28	6	0.12	0.15
Centrifugal Fan	URC-9( )	689-6541	132	253	46	96	10	0.63	0.51
Centrifugal Fan	SRC-20( ) (AM-1565)	729-6191	69	55	27	22	6	0.14	0.09
Tachometer Motor	URC-9( )	843-9429	77	67	31	38	8	0.17	0.20
Tachometer Motor	AN/SRA-33	689-7799	161	28	19	9	4	0.14	0.13
Tube (V104)	RF & PA	840-5465	30	831	46	621	10	2.10	3.30
Tube (V106)	RF & PA	985-9059	15.85	1245	46	725	10	3.10	3.80
Tube 5654 (V20X)	FMO	134-6031	0.98	2004	46	982	10	5.00	5.20
Tube 8532 (V20X)	FMO	134-6149	1.81	1894	46	1226	10	4.70	6.50
Tube (V105)	RF & PA	617-3541	12.13	998	46	751	10	2.50	4.00
Tube 5670 (V80X)	Audio Amp Mod.	134-5994	1.23	1313	45	815	10	3.30	4.30

*Depot-level repairable modules.

Table B-2. SIGNIFICANT PARTS USAGE FOR THE AN/WRC-1( ) FAMILY

Nomenclature	Equipment Part Used In	NIIN	Average Cost (Dollars)	FF-1052 Class			DDG-37 Class			Replacements per Equipment Operating Year	
				Part Replacement	Total Replacement	Ships Reporting	Part Replacement	Total Replacement	Ships Reporting	FF-1052	DDG-37
Translator/ Synthesizer 0.1 KHz*	R-1051( ) T-827( )	167-7673	1312	455	679	46	57	119	8	0.23	0.15
		168-9560	1837	94		17	3		2		
		879-7577	1910	130		32	59		8		
Frequency Standard*	R-1051( ) T-827( )	078-4718	138	531	550	46	117	122	10	0.18	0.15
		160-0623	384	19		15	5		2		
RF Amplifier*	R-1051( ) T-827( )	078-4721	1026	203	569	30	84	137	10	0.19	0.17
		167-7675	989	356		44	50		9		
		168-9559	836	10		9	3		2		
Transmitter IF Amplifier*	T-827( )	969-4216	112	46	46	25	2	2	2	0.05	0.01
Receiver Mode Selector*	R-1051( )	078-4723	261	29	31	20	16	18	7	0.02	0.03
		439-2387	491	2		2	2		1		
Receiver IF Amplifier*	R-1051( )	078-4724	219	132	143	34	60	61	10	0.07	0.10
		168-9561	182	11		8	1		1		
Tube A2A4V1	T-827( ) R-1051( )	574-3818	1	192	192	31	60	60	8	0.06	0.08
Tube A2A4V2	T-827( ) R-1051( )	543-0219	2	264	264	41	100	100	10	0.09	0.13
DC-AC Converter*	AM-3007( )	078-4719	482	3	90	38	2	16	1	0.23	0.26
		179-8081	425	81			13		6		
		133-9034	937	6			1		1		
Tube	AM-3007( )	761-3833	54	143	143	43	16	16	8	0.36	0.26

*Depot-level repairable modules.

Table B-3. AN/WRC-1( ) FAMILY MODULE INTERCHANGEABILITY

Module NIIN	Used In
1. Receiver Mode Selector	
078-4723	
439-2387	R-1051,R-1051B,R-1051D,R-1051E
168-9562	
2. Transmitter Mode Selector	
078-4724	T-827,T-827B,T-827D,T-827E,T-827F
168-9558	T-827,T-827B,T-827D,T-827E,T-827F
3. Receiver/Transceiver IF/AF	
078-4725	R-1051,R-1051B
439-2375	R-1051D,R-1051E
168-9561	R-1051D,R-1051E
4. Transmitter/Transceiver Audio Amplifier	
078-4726	T-827,T-827B,T-827E,
465-6241	T-827,T-827B,T-827D,T-827E,T-827F
168-9554	T-827,T-827B,T-827D,T-827E,T-827F
5. RF Amplifier	
078-4721	R-1051,R-1051B,T-827
167-7675	R-1051,R-1051B,R-1051D,R-1051E, T-827,T-827B,T-827D,T-827E,T-827F
168- 9559	R-1051,R-1051B,R-1051D,R-1051E, T-827,T-827B,T-827D,T-827E,T-827F
6. Frequency Standard	
078-4718	R-1051,R-1051B,R-1051D,R-1051E, T-827,T-827B,T-827D,T-827E,T-827F
160-0623	R-1051,R-1051B,R-1051D,R-1051E, T-827,T-827B,T-827D,T-827E,T-827F
7. Translator Synthesizer	
078-4720	R-1051,T-827
879-7577	R-1051B
167-7673	R-1051B,R-1051D,R-1051E,T-827B, T-827E,T-827F
168-9560	R-1051B,T-1051D,R-1051E,T-827B, T-827D, T-827E,T-827F
8. FSK (RATT) Tone Generator	
078-4722	T-827,T-827B,T-827D,T-827E,T-827F
168-9556	T-827,T-827B,T-827D,T-827E,T-827F

(continued)

Table B-3. (continued)

Module NIIN	Used In
9. Transmitter IF Amplifier	
969-4216	T-827,T-827B,T-827D,T-827E,T-827F
168-9555	T-827,T-827B,T-827D,T-827E,T-827F
10. APC/PPC/Directional Coupler	
078-4717	AM-3007
006-2031	AM-3007, AM-3007A
168-9635	AM-3007, AM-3007A
11. AC Power Supply	
969-4217	AM-3007, AM-3007A
168-8603	AM-3007, AM-3007A
12. DC/DC Convertor	
078-4719	AM-3007
133-9034	AM-3007
179-8081	AM-3007
168-9628	AM-3007, AM-3007A
13. Driver Tube	
988-7994	AM-3924, AM-3924A
14. Final Transformer	
836-2985	AM-3924, AM-3924A
385-1396	AM-3924, AM-3924A
15. VSWR Bridge	
988-8033	AM-3924, AM-3924A
334-7637	AM-3924, AM-3924A
16. Driver Transformer	
836-9140	AM-3924, AM-3924A
17. Power Control PCB	
988-8039	AM-3924, AM-3924A
334-7635	AM-3924, AM-3924A
18. APC/PPC PCB	
988-8043	AM-3924, AM-3924A
334-7633	AM-3924, AM-3924A

Table B-4. MAJOR NTDS REPLACEMENT ITEMS

APL Number	Description	NIIN	Average Cost (Dollars)	Total Cost (Dollars)	Number of Ships Reporting
52379890	AM-3790	111-7152	3,389	61,002	5
		131-6680	548	6,028	3
		993-0836	2,400	16,800	3
			Subtotal	83,830	
57102304	AN/SRA-34( )	979-5927	3,240	16,200	2
		983-4098	3,820	15,780	3
		983-4104	2,072	18,648	3
		983-4106	349	1,745	3
			Subtotal	52,373	
57110801	AN/SRC-16	979-5927	3,020	6,040	1
		983-4098	3,606	18,030	1
		983-4100	3,970	11,910	1
		983-4102	1,694	5,082	1
		983-4110	2,105	4,210	2
			Subtotal	45,272	
57112303	AN/SRC-23A	111-7152	4,941	192,699	5
		113-3494	1,531	13,779	3
		950-8657	87	348	3
		977-6080	256	768	3
		979-5923	643	5,144	3
		979-5927	3,020	3,030	1
		983-4096	1,940	1,940	1
		983-4104	2,450	12,250	2
		983-4111	1,555	9,330	3
		986-0568	662	7,282	3
		993-0836	2,793	47,481	4
		993-0841	3,950	3,950	1
			Subtotal	297,991	
57113110	AN/SRC-31( )	023-0672	1,580	4,740	2
		023-0675	1,330	7,980	3
		042-5702	3,090	3,090	1
		042-5710	6,180	18,540	1
		063-1733	1,030	1,030	1
		076-2172	2,810	5,620	1
		168-3599	668	4,676	4
		168-3600	6,745	107,920	5
		177-6280	2,210	2,210	1
		191-9799	1,483	11,864	4
		433-6080	10,700	10,700	1
		433-6081	4,520	4,520	1

(continued)

Table B-4. (continued)

APL Number	Description	NIIN	Average Cost (Dollars)	Total Cost (Dollars)	Number of Ships Reporting
57113110 (cont.)	AN/SRC-31( ) (cont.)	437-7885	7,610	22,830	2
		437-8103	3,090	3,090	1
		480-7977	1,097	2,194	2
		816-3079	2,000	2,000	1
		913-4209	189	1,323	3
		993-0836	3,400	3,400	1
			Subtotal	217,727	
61397484	C-4784	111-7152	7,320	7,320	1
			Subtotal	7,320	
62689069	C-1169	979-5927	3,020	9,060	1
		983-4098	3,565	7,130	2
		983-4104	854	8,540	3
			Subtotal	24,730	
62689569	CU-1559	437-7917	4,600	4,600	1
			Subtotal	4,600	
76384628	MX-4847	118-8952	150	450	3
		127-3926	1,000	1,000	1
		950-8657	96	384	3
			Subtotal	1,834	
78047492	OA-4792	983-4111	1,536	7,680	2
			Subtotal	7,680	
78047494	OA-4794	111-7152	7,320	7,320	1
		979-5927	3,020	3,020	1
		983-4104	2,450	2,450	1
			Subtotal	12,790	
81130916	R-1361	111-7152	5,232	26,160	3
		113-3494	1,400	8,400	3
		993-0836	2,382	21,438	3
			Subtotal	55,998	
88485894	T-1004	993-0836	2,650	13,250	4
			Subtotal	13,250	
			Total	825,395	

APPENDIX C

CASREP SUMMARY

A total of 238 CASREPs for the DDG-37 Class Exterior Radio Communications System covering the period 1 July 1973 through 30 June 1976 were analyzed to determine the types of critical failures experienced by the system. Table C-1 shows a total of 188 CASREPs (79 percent of the system total) reported against the major equipments of the Exterior Radio Communications System.

Correction times for the submitted CASREPs were examined to determine the average time required to repair CASREP major equipment and to determine whether parts supply problems exist. These results are listed in Table C-2.

Table C-1. SUMMARY OF SIGNIFICANT CASREPs FOR THE DDG-37 EXTERIOR RADIO COMMUNICATIONS SYSTEM

Equipment	Total CASREPs Reported	Percent of System Total	Reason for Failure	Number of CASREPs per Failure
AN/SRC-20( ) Family				
AN/URC-9( )	20	8	RF and PA	4
			FMO	7
			Frequency Selector	2
			First IF Amplifier	1
			Blower Motor	1
			Other	5
AN/SRC-20( )	44	17	RF and PA Assembly	8
			Frequency Multiplier Oscillator (FMO)	5
			First IF Amplifier	2
			Frequency Selector	2
			PA (AM-1565)	4
			Normal Wear	9
			Power Supply	2
			Other	12
AN/SRC-21( )	10	4	RF and PA	4
			FMO	3
			Frequency Selector	2
			Other	1
AN/SRA-33( )	12	5	Tachometer Motor Generator	5
			Power Supply	1
			Normal Wear	1
			Other	5
AN/WRC-1( ) Family				
AN/WRC-1(B)	7	3	Translator/Synthesizer	1
			RF Amplifier	3
			Other	3
R-1051( )	16	5	Frequency Standard	4
			Translator/Synthesizer	10
			Radio Frequency Power Amplifier (RF and PA)	2
			Other	2
AN/URT-23( )	4	2	Power Supply	1
			PA Tubes	2
			Final Transformer Assembly	1
AN/URA-38( )	1		Unknown	1
CU-937	1		Unknown	1

(continued)

Table C-1. (continued)

Equipment	Total CASREPs Reported	Percent of System Total	Reason for Failure	Number of CASREPS per Failure
NTDS Equipments				
AN/SRC-23( )	39	16	RF and PA (1 kW amp)	31
			Lack of Test Equipment	1
			Frequency Standard	1
			Receiver	1
			Other	5
AN/SRC-31(B)	16	7	Intermediate Power Amplifier	4
			VANE Axial Fan Motor	4
			PA Cavity	2
			PA Assembly	2
			Other	4
AN/SRC-16( )	3	1	RF Switching Unit	1
			Tuner	1
			Power Supply	1
CU-1169	1		Unknown	1
AN/SRA-34( )	5	1	Faulty Circuit Card	2
			Other	3
AN/SRA-22( )	2		Unknown	2
VHF Equipments				
AN/URT-7( )	2		Unknown	2
Other Equipments				
AN/URQ-10( )	1		Unknown	1
AM/2123	2		Unknown	2
AN/SRA-43	1		Unknown	1
AN/SRA-57	1		Unknown	1
66047 Whip	1		Unknown	1

Table C-2. CASREP CORRECTION SUMMARY OF THE DDG-37 CLASS EXTERIOR RADIO COMMUNICATIONS SYSTEM

APL	Nomenclature	Days Down			Number of CASREPs	Average Days Down		Percent Down	
		Total	Maintenance	Supply		Per CASREP	NORS Per CASREP	Maintenance	Supply
				AN/SRC-20 Family					
58439716	AN/URC-9( )	438	93	345	20	22.0	17.0	21	79
57112000 57112002	AN/SRC-20( )	886	311	575	44	20.0	13.0	35	65
57112100 57112102	AN/SRC-21( )	202	32	170	10	20.0	17.0	16	84
57102300	AN/SRA-33( )	225	71	154	12	19.0	13.0	32	68
	Subtotal	1,751	507	1,244	86	20.0	71.0	29	71
				AN/WRC-1 Family					
59001105	AN/WRC-1( )	196	111	85	7	28.0	12.0	57	43
81095100 81095102	R-1051( )	493	141	352	16	31.0	22.0	29	71
58557823	AN/URT-23( )	170	16	154	4	42.5	38.5	9	91
58433800	AN/URA-38( )	29	1	28	1	29.0	28.0	3	97
62688437	CU-937( )	18	1	17	1	18.0	17.0	6	94
	Subtotal	906	270	636	29	31.0	22.0	30	70
				NTDS Equipments					
57112303	AN/SRC-23( )	2,061	661	1,400	39	53.0	36.0	32	68
57113110	AN/SRC-31(B)	602	148	454	16	38.0	28.0	25	75
57110801	AN/SRC-16( )	38	23	15	3	13.0	5.0	61	39
62689069	CU-1169	32	9	23	1	32.0	23.0	28	72
57102304 57102334	AN/SRA-34( )	74	21	53	5	4.0	10.5	28	72
57101400	AN/SRA-22( )	34	6	28	2	17.0	19.0	18	82
	Subtotal	2,841	868	1,973	66	43.0	30.0	31	69
				VHF Equipments					
58556509	AN/URT-7( )	34	0	34	1	34.0	34.0	0	100
	Subtotal	34	0	34	1	34.0	34.0	0	100
				Other Equipments					
58532400	AN/URQ-10( )	63	63	0	1	63.0	0.0	100	0
52212301 52212302	AM-2123( )	117	65	52	2	58.5	26.0	56	44
57103223	AN/SRA-43	32	32	0	1	32.0	0.0	100	0
57102357	AN/SRA-57	15	15	0	1	15.0	0.0	100	0
06604700	66047 WHIP	52	52	0	1	52.0	0.0	100	0
	Subtotal	279	227	52	6	46.5	8.5	81	19
	Total	5,811	1,872	3,934	188	31.0	21.0	32	68

APPENDIX D

SHIPALT SUMMARY

Table D-1 lists the Ship Alterations (ShipAlts) that directly pertain to the DDG-37 Class Exterior Radio Communications System and the status of completion. These ShipAlts involve equipment installation unless indicated otherwise.

Table D-1. STATUS OF SHIP ALTERATIONS

ShipAlt and Description	DDG-37	DDG-38	DDG-39	DDG-40	DDG-41	DDG-42	DDG-43	DDG-44	DDG-45	DDG-46
1031K AN/WSC-3	C	C	FY 79	C	FY 80	U	CY 78	U	C	FY 78
1032K AN/SSR-1	C	C	C	C	C	C	C	C	C	C
1047D AN/URC-80	C	C	C	C	C	C	C	C	C	C
1089K AN/URT-23	C	C	U	U	U	U	FY 78	U	U	FY 78
1118D Quick Van	To Be Accomplished As Required By Operations									
1156F Off-Line Crypto	U	U	U	U	U	U	U	U	U	U
1180K Secure Voice	C	C	U	C	U	U	FY 78	U	U	FY 78
1196F Remove AN/WRT-1	C	C	C	C	C	C	C	C	C	C
1247K Single Audio System	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1283D Remove AN/WRR-3	C	C	C	C	C	C	C	C	C	C
1288 Improve Twin Fan Antenna	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

LEGEND: C - Completed
U - Not completed or completion could not be verified
N/A - ShipAlt Work Package not available for installation
FY XX - ShipAlt authorized for accomplishment during overhaul in fiscal year indicated

APPENDIX E

DDEOC ACTION TABLE

DDEOC action items are presented in the table of this appendix. The table is formatted to provide the implementation status of changes through completion of the Class Maintenance Plan and to serve as a ready reference to specific sections in Chapter Three that address in detail the problem involved.

1. ACTION ITEM * a. NO.	1. ACTION ITEM * b. TITLE	2. DDEOC EVALUATION **	3. ACTION ITEM DESCRIPTION	4. REPORT REFERENCE (PARA.)
I	Baseline Overhaul Requirements		A. Inspect for proper bonding at POT&I.	3.8.2
			B. Change Repair Requirements (DDG-37 Class) for SWBS 415 and SWBS 441 from "requirement" (Class B Overhaul) to "reservation" (overhaul as shown to be necessary by POT&I).	3.9
II	Intra-Cycle Maintenance Requirements		None identified beyond current PMS requirements.	3.11
III	Follow-On ROH Requirements		Accomplish overhauls and repairs only as shown to be necessary by POT&I and ship's CSMP.	3.11
IV	IMA Improvements			
	1. Destroyer Tender Test Set Facilities		Depending on the results of ILS recommendation 2, investigate the technical feasibility and cost-effectiveness of installing shop facilities for testing critical equipments.	3.8.1
V	PMS Changes		None identified.	
VI	Reliability and Maintainability Improvements			
	AN/SRC-20( ) Family			
	1. RF & PA, FMO, and Audio Amplifier Modules.		Install solid-state modules as available.#	3.3
	2. Centrifugal Fan and Speed Increaser		Design and develop a Field Change to install a low-rpm alarm.	3.3
	AN/WRC-1( ) Family			
	1. Translator/Synthesizer		Provide replacements of solid-state modules when available.#	3.4
	2. Frequency Standard		Give priority to providing modified modules.#	3.4
	3. RF Amplifier		Provide solid-state module.#	3.4

* NOTE 1: DEVELOPING ACTIVITY FILL IN THE FOLLOWING BLOCKS: 1a, b; 3; 4; 5 (IF KNOWN); 6a, IF REQUIRED FOR CONTIN

** NOTE 2: DDEOC EVALUATION – APPROVED, FURTHER STUDY REQ'D, ETC.

† NOTE 3: RESPONSIBILITY – ACTIVITY RESPONSIBLE FOR TAKING THE ACTION.

NOTE 4: IMPLEMENTATION IS IN PROGRESS AS A RESULT OF PREVIOUS FF-1052 CLASS ERCS SMA.

SHIP CLASS: DDG-37

SMA NO: 39-301-441

SYSTEM: Exterior Radio Communications System

DDEOC ACTION TABLE

	4. REPORT REFERENCE (PARA.)	5. RESPONSIBILITY †	6. SCHEDULING DATES a. REQD.	b. START	c. COMP.	7. REMARKS, FUNDING IMPLICATIONS, ETC.	8. ACTUAL ACTION TAKEN
POT&I.	3.8.2						
G-37 41 from 1) to wn to be	3.9	NAVSEA/PERA					
S	3.11	TYCOM					
only as d	3.11	NAVSEA 934					
ecomm- ical s of sting	3.8.1	NAVELEX					
ailable.#	3.3	NAVELEX					
to	3.3	NAVELEX					
te	3.4	NAVELEX					
ed	3.4	NAVELEX					
	3.4	NAVELEX					

QUIRED FOR CONTINUATION OF DEVELOPING ACTIVITY TASK, 7, AS NECESSARY.

1 ACTION ITEM *		2 DDEOC EVALUATION **	3 ACTION ITEM DESCRIPTION	4 REPORT REFERENCE (PARA.)
a. NO.	b. TITLE			
	AN/SRC-20( ) Family (Cont)			
	4. Final Transformer Assembly		Provide improved commercially available modules.#	3.4
	5. DC-DC Converter		Provide Field Change to improve module.#	3.4
	6. Wire Antenna Strain Insulators		Procure and backfit insulators with grounding strap stud in place.#	3.4
	7. Simo-Keying H.F. Transmitters		Develop a Field Change or ShipAlt to permit Simo-Key operation.#	3.4
	NTDS			
	1. AN/SRC-23( ) RF PA Module, NIIN 111-7152		Investigate the feasibility of redesigning the RF PA module to incorporate solid-state technology.	3.5.1
VII	Integrated Logistic Support			
	1. AN/SRC-23( ) RF PA Module, NIIN 111-7152		Increase on-board spares allowance from one to two.	3.5.1
	2. Supply Support		Initiate a study for determining to what extent the ERCS repairable assemblies and modules, which are not faulty, are being returned for refurbishment.	3.8.1

* NOTE 1: DEVELOPING ACTIVITY FILL IN THE FOLLOWING BLOCKS: 1a, b; 3; 4; 5 (IF KNOWN); 6a, IF REQUIRED FOR CONTINUA

** NOTE 2: DDEOC EVALUATION – APPROVED, FURTHER STUDY REQ'D, ETC.

† NOTE 3: RESPONSIBILITY – ACTIVITY RESPONSIBLE FOR TAKING THE ACTION.

NOTE 4: IMPLEMENTATION IS IN PROGRESS AS A RESULT OF PREVIOUS FF-1052 CLASS ERCS SMA.

SHIP CLASS: DDG-37

SMA NO: 37-301-441

SYSTEM: Exterior Radio Communications System

DDEOC ACTION TABLE

	4. REPORT REFERENCE (PARA.)	5. RESPONSIBILITY †	6. SCHEDULING DATES a. REQD.	b. START	c. COMP.	7. REMARKS, FUNDING IMPLICATIONS, ETC.	8. ACTUAL ACTION TAKEN
lable	3.4	NAVELEX					
dule.#	3.4	NAVELEX					
h	3.4	NAVELEX					
to	3.4	NAVELEX					
esign-e	3.5.1	NAVELEX					
from	3.5.1	NAVSEA 934					
o sem-aulty, nt.	3.8.1	NAVSEA 934					

UIRED FOR CONTINUATION OF DEVELOPING ACTIVITY TASK; 7, AS NECESSARY.

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The goal of the Destroyer Engineered Operating Cycle (DDECO) Program is to effect an early improvement in the material condition of the of ships, at an acceptable cost, while maintaining or increasing theri operational availablity during an extended operating cycle In support of this goal, System Maintenance Analyses (SMAs) are being conducted for selected systems and subsystems of designated surface conbatants. The principal element of an SMA is the Review of Experience (ROE). This report documents the ROE for the DDG-37 (Over)

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